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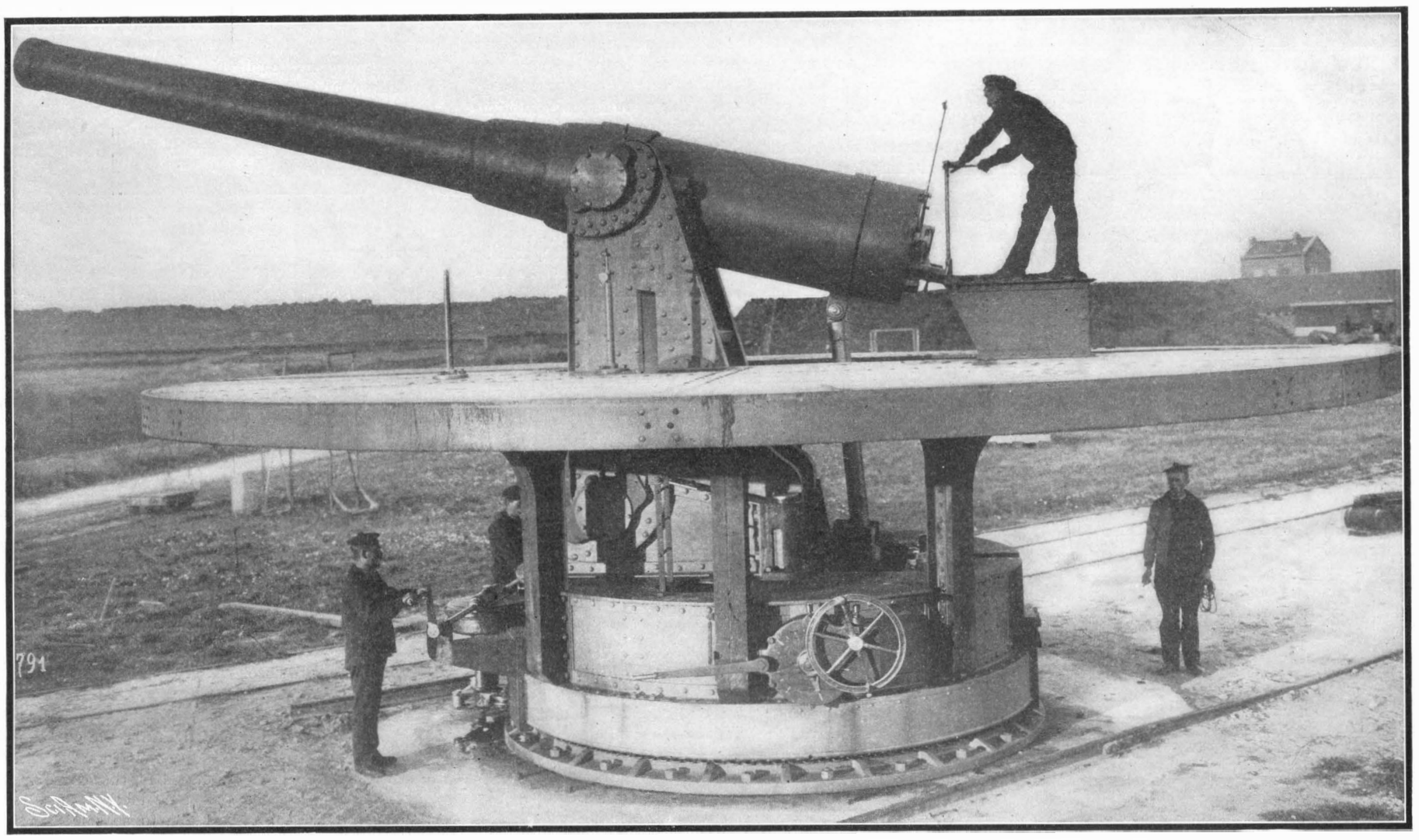
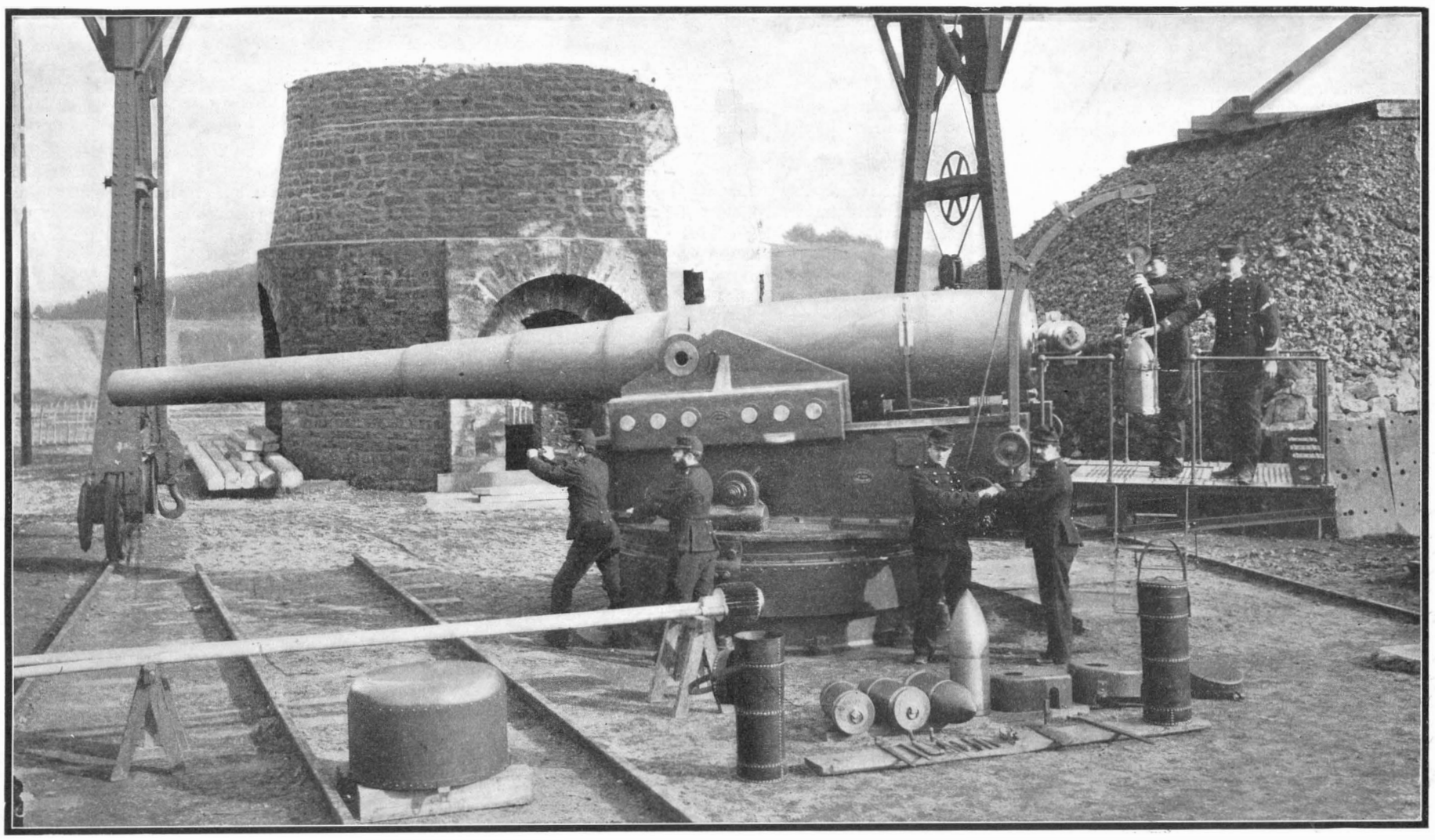


This gun recoils below the circular horizontal shield, and is loaded in that position, rising above the shield to fire.

Ten-Inch Canet Coast Defense Gun on Disappearing Carriage at the Proving Grounds.



The gun is permanently exposed, the carriage and gun detachment being sheltered below the parapet.

Ten-Inch Canet Coast Defense Gun Mounted en Barbette on Proving Grounds.

THE JAPANESE ARMY AND ITS GUNS.—[See page 425.]

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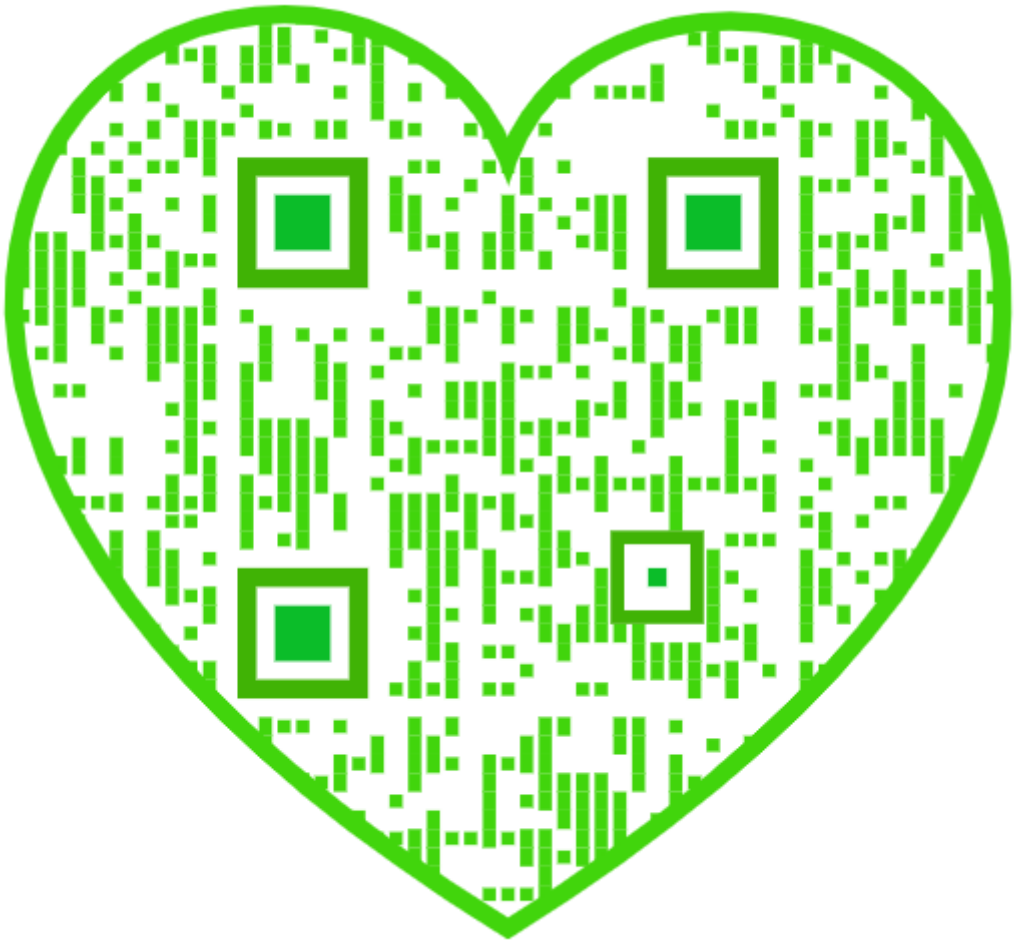

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NEW YORK, SATURDAY, MAY 28, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

INCREASING RAILROAD FATALITIES.

The latest accident report of the Interstate Commerce Commission opens with a statement of the number of killed and wounded on the railroads of the United States during the last quarter of 1903, which, in its bald and succinct enumeration of losses, reads not unlike a statement of killed and wounded sent from one of the battlefields of the Far East. There is one striking point of difference, however, and that is that the casualties, although the record covers only three months, far exceed in magnitude the total number of killed and wounded since the opening of the Russo-Japanese war. We give the opening sentence of the report in the exact words in which it describes what is at once a supreme national tragedy and an abiding national disgrace: "The number of persons killed in train accidents during the months of October, November, and December, 1903, as shown in reports made by the railroad companies to the Interstate Commerce Commission, under the 'Accident Law' of March 3, 1901, was 446, and of injured, 3,178. Accidents of other kinds, including those sustained by employes while at work, and by passengers in getting on and off the cars, etc., bring the total number of casualties up to 14,485, or 1,166 killed and 13,319 injured."

We have not the figures for the total number killed and wounded thus far in the eastern war; but we think it is pretty safe to say that the grand total will fall considerably short of 14,485; and, mark you, these statistics cover but ninety days, which is about three weeks' less time than the present duration of the war.

This record for the last quarter of 1903 has certain features which render it distressingly memorable. It includes the worst passenger train accident, judged by the number of fatalities, that has occurred in this country for fifteen years, and it records also six terrible accidents which caused among them 106 deaths and 196 injuries, in consequence of which the present Bulletin contains the greatest number of fatalities of any published since the Interstate Commerce Commission began to gather these statistics. Indeed, the number killed in this three months is more than three times the average number killed during the nine preceding quarters. Only four other train accidents have occurred in this country which have caused as many deaths as that which took place last year in Pennsylvania, when 65 people were killed. One of these occurred in 1888 at Mud Run, Pa., when 66 people lost their lives; another was the disaster at Chatsworth, Ill., in 1887, when 85 were killed; then in 1876, there were 80 deaths by the collapse of a bridge at Ashtabula, Ohio; the other accident exceeding the recent disaster in the number of killed was that at Camp Hill, Pa., in 1856, when there were 66 fatalities. Although the large increase in fatalities during the period now under review was caused by a few extremely disastrous accidents, the huge total for the quarter of nearly 15,000 casualties represents an enormous number of collisions and derailments, 1,832 of the former and 1,179 of the latter, making a total of 3,011 accidents in a single quarter of the year.

The report gives some details regarding the most fatal of the accidents, and the quarter in which the blame is to be placed. From this it appears that the derailment that occurred on the Pennsylvania Railroad, with 65 fatalities, happened to a passenger train which, when running at 45 miles an hour, struck some heavy timbers which had broken loose from a lumber car and were projecting over the adjoining track. The cause of the accident is reported as "carelessness on the part of employes of the lumber yard in not selecting stakes of good quality and size to make the load secure, and failure of the car inspectors to detect this defect." Another collision, resulting in the death of 32 passengers, was blamed to "negligence on the part of the men in charge of both the trains involved." The foremost train, which was behind time, was standing in the station, and an express was due. The rear flagman waited until he had assisted the passengers to alight before he went back to give warning, and then had only gone back 200 feet before the express was upon him. The engineer of the express could have seen the local train's red lights on the last car at a point 2,800 feet to the rear. Another collision, in which 18 were killed, was due to the fact that, in a heavy storm of wind and snow, a signal light had been extinguished. Here the blame was on the engineer of the colliding train for not coming to a stop to learn why the light was not burning. In two other collisions involving the loss respectively of 17 and 16 people, the first was caused by failure of the brakeman to flag the following train, and the other by the conductor and engineer of a passenger train disregarding the rule to run through a yard with speed under control, with the result that the train collided with a switching engine. And so the record runs, the collisions being due almost invariably to neglect or carelessness on the part of the employes. This would seem to indicate that the fault is to be charged to the human element more than to the materials of modern railroading. Or in other words, if we would seek for the explanation of the enormous excess of accidents in this country over those of European systems, we must look for the explanation more in the temperament of the people than in the character of the roadbed, rolling stock, and regulations.

THE JAPANESE DISASTER AT PORT ARTHUR.

The destruction of a 15,000-ton battleship is an irreparable loss, no matter how rich and powerful be the nation that suffers. Not merely does it mean the absolute loss of property valued at from six to seven million dollars, but it leaves a gap in the defenses of the nation which, for the time being, and indeed for many years to come, must remain unclosed. Particularly is this true of that gallant little fleet of half a dozen battleships to which the initial successes of the Japanese forces are due, and without which not a man or a gun could have been landed upon the Asiatic main. We say this advisedly; and we commend the statement to the serious consideration of that happily limited section of Congress, which would have us believe that the day of the battleship has passed, and the era of the torpedo boat and fast cruiser has opened. A fleet without battleships would be in the position of an army without a base; particularly where the operations are of an aggressive character, and carried out hundreds of miles from a friendly port or dockyard.

When the war opened, Russia, with her fleet of seven battleships, and a numerous complement of armored and protected cruisers and destroyers, backed by the seemingly impregnable naval bases of Port Arthur and Vladivostock—to say nothing of the formidable fleet that was nearing completion in European waters—seemed to hold a practically secure position. The hope of Japan lay in its fleet of six battleships. With remarkable audacity and skill she planted this squadron in front of Port Arthur, where it formed a floating base for the operation of cruisers and torpedo boats, which latter, by a swift dash at the opening of the war, so far crippled the enemy as to give Japan the command of the sea. One immediate result of the Russian reverses was the determination to dispatch the Baltic squadron for the relief of Port Arthur; and from the moment that this was determined upon, it became doubly imperative upon the Japanese admirals to maintain the blockade of Port Arthur and hold the whole Russian fleet with the least possible amount of risk to their battleship squadron, already too small for the gigantic tasks that confronted it during the coming months, and possibly years, of the war. It has been a matter of surprise that Admiral Togo should have conducted his victorious operations with so little loss in ships and men; particularly in view of the fact that Port Arthur is known to contain a numerous torpedo-boat fleet, and that the mining of the waters has been carried out with a recklessness that promised to be as dangerous to friend as to foe. At last the inevitable has happened, and one of the finest of Togo's battleships, the "Hatsuse," has been sunk by one or more of the floating mines with which the waters of the Liao-tung peninsula are strewn. So suddenly did this great ship go down that only 300 out of her crew of 750 were saved. On the same day and within a few hours of this disaster the Japanese cruiser "Kasuga," in a deep fog off Port Arthur, rammed the cruiser "Yoshino," the latter sinking so rapidly that only 90 out of her crew of 300 men were saved. The loss of the cruiser is unfortunate, but it is insignificant compared with the loss of such a magnificent ship as the "Hatsuse," which shared with the "Mikasa" the distinction of being one of the largest battleships afloat in any navy.

The "Yoshino" was a protected cruiser of 4,150 tons displacement and 15,000 horse-power, built in England in 1892. Her speed was 23 knots, and she mounted four 6-inch guns, eight 4.7-inch guns, and twenty-two 3-pounders. Her armored deck was 4½ inches thick, and she carried five torpedo tubes.

The "Hatsuse," built at Elswick in 1899, carried four 12-inch, fourteen 6-inch, and twenty 3-inch guns, and was fitted with four submerged torpedo tubes. She was protected by a belt of Harvey nickel-steel, 9 inches thick amidships and 4 inches at the ends, and her deck was 4 inches thick on the slopes. Her 12-inch guns were protected by 14 inches of armor on the barbettes and 10 inches on the hoods. The battery of 6 inch guns was carried in casemates protected by 6 inches of armor. She was practically a sister ship to the "Shikishima." With a maximum supply of 1,500 tons of coal and a trial speed of over 19 knots, the "Hatsuse" was about as fine a sample of modern battleship construction as could be found.

The effect of this double loss will be to revive the spirits of the Port Arthur garrison and fleet, and instill new life into the project of sending the European fleet to the Far East. This, if the Black Sea ships be included, may easily consist of eight first-class battleships, and these with the three that are supposed to be still intact at Port Arthur, would give a preponderance, supposing Port Arthur can hold out for another few months, that must be giving the Japanese government most anxious concern.

RUSSIAN NAVAL GUNS.

BY FRED T. JANE.

Russian guns—the more modern ones, at any rate, which are practically Schneider-Canets—have, like the Belleville boiler and several other products of French genius, the reputation of being "very complicated." This is the verdict usually passed upon them by those whose technical acquaintance with artillery is confined to other types. Like the Belleville, their "complications" upon closer acquaintance turn out to be the result of practical experience, and they are complicated only because novel. Actually, Russian guns are simple enough to work, and the only thing about them puzzling to those of other nationalities is the duplication of safety devices specially provided for sailors whose general average of intelligence is below that of the men of most other nations. In this thing alone do the newer Obuchoff models differ from the French Schneider-Canet pieces on which they are modeled.

The result is some slowing of fire, because before the gun can be discharged, at least two, and occasionally three, safety devices have to be loosed. This is essentially a drawback, regarding the guns as guns, but by no means so when the Russian bluejacket is taken into account. One man is usually detailed to release these safety devices; if he fails, the gun cannot be fired, as there is no contact. All chance of firing with the breech improperly closed is, therefore, avoided by human instead of automatic mechanism. As a Russian sailor is normally liable to be somewhat erratic, there is no question of the advantages secured.

The standard guns in the Russian fleet are as follows:

The 12-inch of 40 calibers; weight, 59 tons; muzzle velocity, 2,500 foot-seconds; muzzle energy, 32,000 foot-tons. This piece has a nominal penetration of 15½ inches Krupp cemented at 3,000 yards with capped A. P. shell, the same as that of the United States Mark III. 10-inch, built for the "Washington" class. It is mounted in the "Retvizan" and "Czarevitch." For the "Borodino" class, a 64-ton 12-inch has been designed, but it is doubtful whether it exists as yet. It has the same velocity (service), but fires a 1,200-pound projectile instead of a 732-pound one, and it has a correspondingly increased energy. The nominal velocity is 3,000 foot-seconds.

The "Poltava" class, the "Sissoi Veliky," and all other battleships carrying 12-inch guns, down to and including the "Sinope," carry a 35-caliber, 12-inch gun. Its weight is 56 tons, its initial velocity 1,942 foot-seconds (service), energy 19,200 foot-tons, shell 732 pounds. It is, of course, an old-type gun. Its penetration is for a 12-inch gun very small. The velocity is poor, and the piece is considerably inferior to the Japanese 12-inch gun. The rate of fire of this piece is slow.

A more powerful piece and a better gun is the 10-inch of 45 calibers, carried by the "Peresviet" class and the "Apraksin" and "Rostislav." Its ballistics are inferior to those of the United States 10-inch Mark III., but it is superior to the "Iowa's" gun, being able to penetrate 13-inch Krupp armor at 3,000 yards. As a gun, it is the finest heavy piece in the Russian service, and its rate of fire and accuracy are both good. It was seriously contemplated a few years since to have this piece only, its results being so superior to those of the 12-inch 35-caliber gun. It weighs 38 tons, and has a velocity of 2,500 foot-seconds at the muzzle. It keeps up the velocity well; but the exact weight of the projectile is not known. It is somewhere about 500 pounds. Velocities of, or over, 3,000 foot-seconds have been accredited to it; but these are merely trial results. Its defect is that the penetration is poor at long ranges, where the velocity drops, and the relatively light projectile tells against it.

The "Gromoboi" and "Bayan" carry a 45-caliber rapid-fire 8-inch gun. Its mechanism is somewhat

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tardy, and the rate of fire only about once a minute; but the gun is excellently constructed, and has very fine ballistics. It weighs 20 tons, fires a 250-pound projectile, and has velocities up to 3,000 foot-seconds, though the service velocity is lower than this. Its service penetration is about 8 to 9 inches of Krupp armor at 3,000 yards. The new 7-inch is the United States gun it most nearly resembles in power; but its energy is better on account of the heavier projectile.

The 6-inch rapid-fire is of 45 calibers, and fires shell of both 111 and 88 pounds weight. The service velocity is 2,460 foot-seconds, and the weight of the gun about 7 tons. It is nominally equal to 6 inches of Krupp armor at 3,000 yards. Its rate of fire is moderate. In the latest ships it is mounted in a completely circular shield inside the casemate. The "Czarevitch" carries this gun on a twin mounting, as do the "Poltava" class. This mounting has given very satisfactory results as such mountings go. They always leave something to be desired. The 4.7-inch is a piece of 45 calibers about on a par with corresponding pieces in other navies.

All these guns have the Schneider-Canet breech mechanism, which is not equal to the Welin for rapidity, though less liable to derangement. A Russian innovation is a carrier below the breech block, so that when the latter is opened, its weight is not thrown on the hinges. The mounting details and rifling follow the Canet system.

Most Russian ships have electric hoists. Their guns all use nitro-cellulose smokeless powder. The projectiles are capped armor-piercing shell, and common shell. No solid shot is used, as the Russians claim to find their capped armor-piercing shell equally penetrative. High explosives are not yet introduced. Fuses are the weak point in Russian gunnery.

Newspaper reports have made the aiming very bad; but enough account was not taken of the range at Port Arthur. There are some very good shots in the Russian fleet, and the average gunnery officer is efficient. He is able, and often acts as captain of a gun, as do other officers. Where the Russian fleet came to grief was in the fact that gunnery was totally neglected by Admiral Stark, who devoted his time to battle evolutions of the parade ground type.

In conclusion, mention may be made of a few other guns in the Russian service. A 9-inch piece exists in some small coast defenders and armored gunboats. It is an obsolete gun, of which little is known and still less is worth knowing. There is also an old 8-inch in the "Rossia" and "Rurik." It is 35 calibers long, and its highest velocity is 1,922 foot-seconds. Its penetration is poor and its firing slow—it is less penetrative, in fire, than modern 6-inch guns.

THE MOTHER OF EXHIBITIONS.

BY HERBERT W. HORWILL.

In the centuries before the nineteenth, the nearest approach to an international exhibition appears to have been the Frankfort fairs of the sixteenth century. Henry Estienne, the scholar, describes this institution as "the epitome of all the markets of the world." But it is from an event within the memory of many persons now living that the fairs at Philadelphia, Chicago, Buffalo, and St. Louis trace their genealogy. The mother of all such displays was the exhibition held in London in 1851. This was itself an outgrowth of a series of exhibitions of art manufactures held by the Society of Arts, at the suggestion of its secretary, Mr. F. Whishaw, from 1847 to 1849. These consisted merely of a collection of articles made in the British Isles; and the Prince Consort, who was president of this society, improved on the experiment by making the bolder proposal that there should be brought together an exhibition representing the skill of the whole of the civilized world. It is surely one of the curiosities of history that such democratic institutions as these exhibitions are considered to be should have owed their impulse not to any popular movement whatever, but to a suggestion that came from Buckingham Palace, and that needed all the weight of royal influence to overcome the obstacle of popular indifference and opposition.

On June 30, 1849, the matter was laid before a meeting of the Society of Arts called by the Prince Consort at the palace. On October 17 of the same year, the leading bankers and merchants in the city of London were consulted. On January 3, 1850, there was taken the important step of the appointment of a royal commission to be responsible for managing the venture. Its members were Henry Cole (afterward secretary of the Science and Art Department), C. W. Dilke (father of the present baronet), Robert Stephenson, and Digby Wyatt. One of its secretaries was Stafford Northcote, distinguished later as a cabinet minister and Conservative leader in the House of Commons. Northcote's exertions in connection with this project did much to bring on the physical weakness which afterward lessened his effectiveness as a statesman. The exhibition also owed much to Lyon Playfair, the scientist, whose biography shows that at one time his tact prevented the whole undertaking from coming to grief. Playfair's special skill was in organization and in the application of scientific discovery to industrial improvement—talents which found special opportunities of exercise in this connection.

The scheme was fully launched on March 21, 1850, at a Guildhall banquet to which the Lord Mayor invited the chief officers of state, the foreign ambassadors, and the mayors of the provincial towns. The principal speaker was the Prince Consort himself, who asked their co-operation in the attempt "to give the world a true test, a living picture, of the point of industrial development at which the whole of mankind has arrived, and a new starting point from which all nations will be able to direct their further exertions." The reception of the proposal at this dinner was gratifying, but to obtain the active assistance of those whom the guests represented was a wearisome task. The forces of old-fashioned Toryism in Parliament, and the press, deliberately set themselves to ruin the whole thing. The most violent opponent in the House of Commons was a certain Col. Sibthorp, who especially feared the demoralization of the national character that would ensue from the visit to England of a large number of persons from the Continent. "Take care of your wives and daughters; take care of your property and your lives," was the warning he passionately and sincerely addressed to his fellow countrymen. The Times was dead against the plan, and Punch did its best to turn it into ridicule. In one of Leech's cartoons the Prince Consort was represented as "The Industrious Boy," holding out a cap on which was inscribed, "Please remember the exposition."

As the various details of the scheme developed, its opponents attacked them in turn. There was, for instance, the question of the site. The government first offered the area included in Somerset House, but this was obviously much too small for anything on the scale projected. The Prince suggested Hyde Park. An outcry arose against the spoiling of one of the most delightful spots in the metropolis. A petition sent to the House of Lords against the use of the park received the support of Lord Brougham, and a resolution to the same effect was introduced into the Lower House also. In a letter of the Prince's to Stockmar, dated June 28, 1850, he says: "The exhibition is now attacked furiously by the Times, and the House of Commons is going to drive us out of the park. There is immense excitement on the subject. If we are driven out of the park, the work is done for. Never was anything so foolish." In a letter to the Duchess of Kent, dated July 4, there is a similar reference, from which it appears that the opposition party were urging that if such a nuisance must take place, a site should be found for it in the Isle of Dogs—a dismal swampy region further down the river, occupied to-day by the West India and Millwall docks. Happily, on the same date as the second of these letters, the Parliamentary opponents of the Hyde Park site were defeated in a division, and that difficulty was overcome.

Then came the problem of finance. In view of the strength of the antagonism to the scheme, the Prince wisely forbore making any attempt to secure an appropriation from Parliament, and trusted entirely to the public spirit of his supporters. Mr. Samuel Peto, with his partners in the well-known banking firm which bore his name, led the way on July 12, 1850, by the offer of $250,000 to a guarantee fund. Ultimately the actual subscriptions toward the cost of the exhibition amounted to $375,000, and the guarantee fund to $1,000,000. The undertaking was so entirely experimental that there was no knowing whether the whole of this sum would not be required to meet the cost.

Both site and money having been obtained, the way seemed clear for the prosecution of the work. But just at this point the commission was confronted by one of the most puzzling situations in the history of the movement. In what kind of structure should the exhibits be housed? Out of two hundred and thirty-three plans submitted, not one appeared satisfactory. Each of them contemplated the erection of a huge brick building, which would have justified all the protests that had been made against the defacement of the park. At the last moment light came, not from a professional architect, but from a gardener. Joseph Paxton, whose solution of this problem made him famous, was the son of a Bedfordshire farmer. In his youth he drifted from place to place in pursuit of his occupation as gardener. In 1826, at the age of 25, he was on the point of emigration to this country, as his earnings were only eighteen shillings (four and a half dollars) a week; but he happened to attract the attention of the Duke of Devonshire, who made him superintendent of the gardens at Chatsworth. Later he was promoted to be responsible for the woods and forests on the estate also. In 1840 he completed the erection of the Chatsworth Conservatory, the largest of the kind hitherto constructed. One day, while waiting for his train at a railway station, and reflecting upon the difficulty of the exhibition commissioners, he was suddenly struck by the idea that an adaptation of the conservatory system would get them out of their *impasse*. Sitting at the table of the waiting room, he hurriedly sketched on a piece of blotting paper a rough outline of a building, and within nine days completed a set of plans which were immediately accepted. The essential feature of his scheme was that the structure should be, not of brick, but of glass and iron, with the exception, of course, of the flooring and joists.

Paxton's plans were accepted on July 16, 1850. The actual building operations commenced on September 26. The contractors were Messrs. Fox and Henderson, to whom it was agreed to pay $399,000, or $750,000 if the building was retained as a permanency. The exhibition structure, which covered eighteen acres, was in the form of a parallelogram 1,851 feet (corresponding to the number of the year) by 408, with a projection on the north 936 feet long. Col. Sibthorp's kindly prayer that lightning or a hailstorm might destroy the building while in course of construction was not answered. By New Year's Day it was complete, and was handed over to the commissioners.

What especially impressed the imagination of those who inspected the building was the sight of giant elms, former ornaments of the park, which rose toward the roof without any more obstruction than if the space on which they stood were still uncovered. On February 12, 1851, the building was opened to exhibitors for the reception of their goods.

Even when this stage had been reached, the malcontents had not all been converted. From a letter of the Prince Consort's as late as April 15, it appears that there were predictions that foreign revolutionists would use the opportunity to upset the monarchy and establish a republic, and that the confluence of so great a multitude would cause an outbreak of plague. The apprehension was as great in some circles on the Continent as in England. Mr. Sidney Lee, in his biography of Queen Victoria, notes that the wish of the Queen and her husband that all national rulers or their representatives should be their guests on this occasion, had to meet the fear of many foreign sovereigns lest the assembly of several crowned heads in one place should be an incitement to the attempts of conspirators. It was with great difficulty that the Prince of Prussia was persuaded to accept an invitation to be present with his son. The Prussian minister in London wrote home that a number of madmen had already assembled, and intended to work irretrievable disaster by interrupting the succession to the Prussian throne. Lord Granville suggested to the diplomatic colony in London that on the opening day they should present an address to the Queen in recognition of the fact that the object of the exhibition was not purely British, but international, but they declined to do so.

The opening ceremony on May 1, 1851, was naturally awaited with the greatest anxiety by the promoters of an undertaking which had been regarded with so much doubt in some quarters and open animosity in others. It was a brilliant success. One of the most interesting descriptions of the event may be read in the "Letters of Dean Stanley." He speaks of what happened immediately the public were admitted as "one of the most ridiculous scenes I ever saw." Nobody stayed to look at a single exhibit, but everyone made his way, first at a trot and then at a full gallop, to the transept, where the Queen was presently to appear and declare the exhibition opened. As the crowd entered from several doors on each side of the building, this throng converging at racing speed upon the center must indeed have provided a comical spectacle to those who were not in too great a hurry to look around them. The opening ceremony itself was dignified and impressive. In all the assembly the persons to whom the success or failure of the exhibition meant most were the Prince Consort, by whose initiative it had been undertaken and who had staked upon it his influence in the country; and the Queen herself, so closely affected as she always was by everything that concerned the welfare or honor of her husband. It is little wonder that Stanley describes her as flushed with a kind of excitement he had never witnessed on any other human countenance. Never before, too, says Stanley, had he seen her look so thoroughly regal. Still possessing a youthful capacity for a quick response to outside impressions—for she was then only in her thirty-second year—she spoke of it afterward as the proudest and happiest day of her life. No disaster or even disturbance marred the celebration. There were 25,000 persons in the building at one time, and 700,000 lined the route of the royal procession between the exhibition and Buckingham Palace, yet there was not one accident or police case.

The tide of public opinion had now turned. In the reaction, forecasts of revolution and disorder were succeeded by the most extravagant forecasts of millennial peace, which would directly result from the friendly meeting of citizens of many nations. How was it possible that those who had thus learned to associate in the gentle rivalry of invention and industrial skill could ever again draw the sword against one another? The Crimean war, three years afterward, was the answer to these imaginations, to say nothing of later conflicts which have embroiled in deadly struggles almost every leading power represented at

(*Continued on page* 423.)

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TRANSPORTER BRIDGE ACROSS THE MANCHESTER SHIP CANAL.

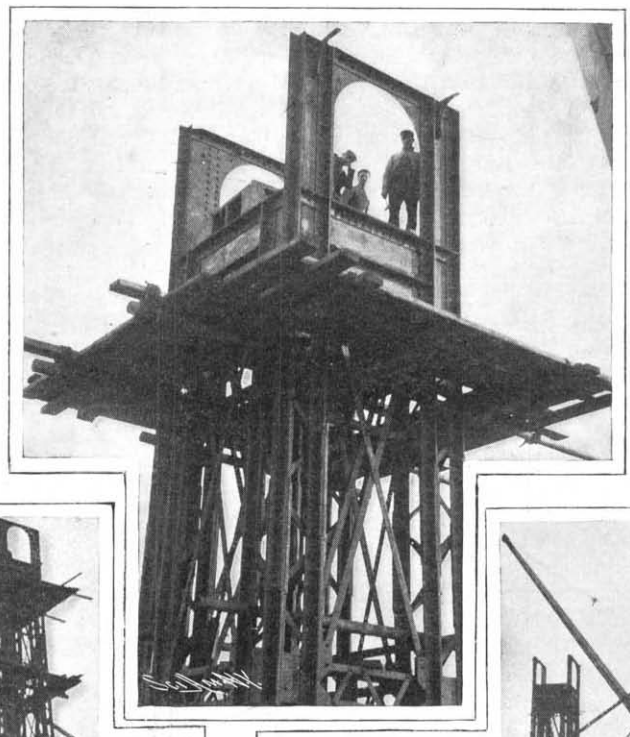
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

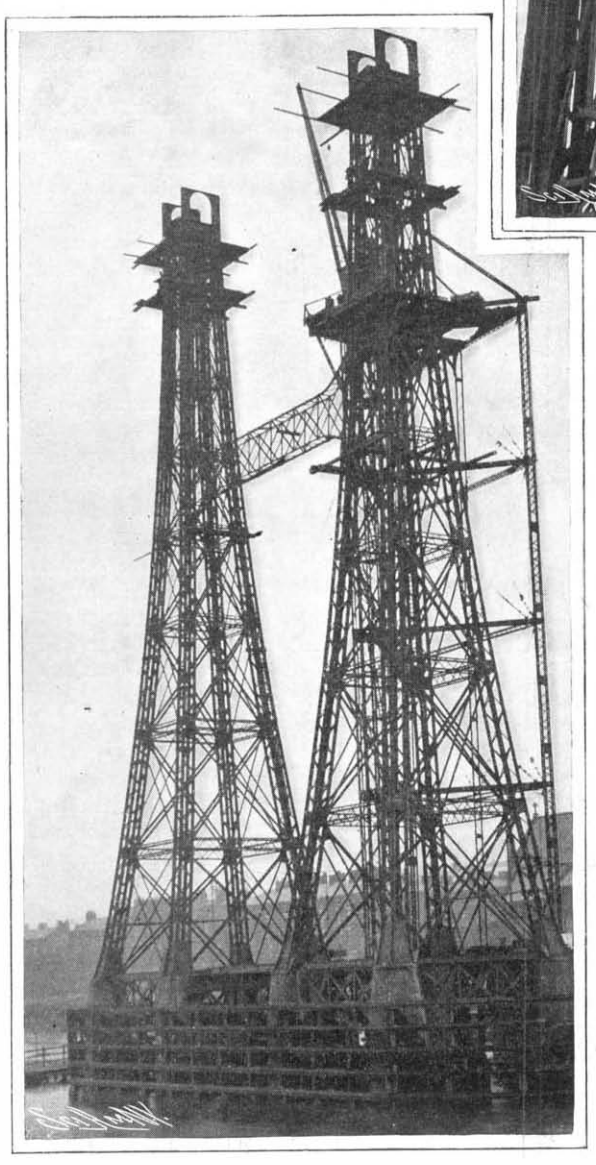
The latest transporter bridge is now nearing completion across the Manchester ship canal in England, connecting Widnes and Runcorn on opposite banks of the river Mersey.

The structure when finished will be the largest of its type, as it will have a clear span of 1,000 feet. In design it is exactly the same as an ordinary stiffened suspension bridge, except that the approaches to the bridge are at a low level, and both vehicular and pedestrian traffic will be carried across the river in a car suspended from the bridge. The utilization of low-level approaches dispenses with the erection of costly high-level approaches, which are necessary to give admittance to the suspension bridges of the general type.

The idea of a transporter ferry bridge originated from Mr. Charles Smith, of Hartlepool (England), who suggested the construction of such a structure across the River Tees at Middlesborough over thirty years ago, but his suggestion never saw fruition.

The Runcorn and Widnes bridge, although similar in the main principles to that at Bizerta, is widely dissimilar in its general construction. The 1,000-foot span gives adequate clearance over both the river and the Manchester ship canal. The bridge is approached from both banks by an almost flat roadway at a suitable level, built between stone and concrete retaining walls right up to the water's edge. From this point over the foreshore to the base of the towers, the approach is carried upon steel elliptical girders resting upon cast-iron columns, supporting a corrugated steel flooring upon which is laid wood paving on a concrete bed. This section of the roadway is 35 feet wide between parapets with sidewalks 6 feet wide on either side.





The Towers in Course of Construction. The Top of a Tower. General View of Transporter Bridge Towers on Both Banks.

The towers which carry the cables and the stiffening girders are constructed throughout of steel, and rise to a height of 190 feet above high-water mark. There are four towers in all, two at either end, and each tower is firmly bolted to four cast-iron cylinders, each of 9 feet diameter. These caissons are firmly bolted to a solid rock foundation.

Each tower consists of four legs, 4 feet 10 inches wide at the base, tapering to a width of 2 feet 3 inches at the top, firmly and strongly braced together with strong horizontal and diagonal bracing. At the base of each tower the legs are 30 feet apart, narrowing to 6 feet 9 inches at the top landing, which is 10 feet 6 inches wide. Each pair of towers is 70 feet apart, and braced together with strong horizontal and diagonal frames. The saddles, on steel rollers, for carrying steel cables, are fixed at the top of each tower. The rollers are adapted for taking up the variations in the length of the cable due to the loads and climatic conditions.

There are two main steel cables. Each consists of nineteen steel ropes bound together, a rope being composed of 127 wires of 0.16 inch diameter, so that each cable is built of 2,413 wires. The total diameter of the cable is about 12 inches. The two cables represent a weight of 243 tons, and the wire is capable of withstanding a tensile strain of 95 tons per square inch. The interstices that are left between the wires of the ropes are filled during the process of manufacture with a bituminous compound. The ropes are laid in parallel, and when made up into the cable, the whole mass is covered with a layer of the same compound, and the whole is then incased in two layers of strong sail cloth saturated with bitumen.

The anchorages of the cable backstays are in the solid rock about 30 feet deep, with screw adjustments fixed between the anchorages and the backstays.

There are two longitudinal stiffening girders suspended from the main cables, 18 feet deep, and placed 35 feet apart horizontally. The underside of the girders will be 82 feet above the high water of the river below, thus leaving plenty of clearance for the passage of the largest vessels underneath. In the center they will be hinged so as to minimize the stress arising from the deflection from temperature, the girders rising and falling as much as 2 feet 9 inches for a range of temperature of 60 deg. F. on each side of an average temperature of 60 deg. F. In order to allow for the longitudinal expansion and contraction, a unique arrangement has been adopted. The girders are fixed to vertical rockers, which furthermore carry the overhang of the girders when the car is in the dock at the towers.

The transporter car or ferry comprises a platform 55 feet in length by 24 feet beam, suspended by steel wire ropes from the trolley above. The ropes are so hung that they prevent either side or end oscillation of the car. The latter will be of sufficient dimensions to accommodate at one time four large two-horse wagons and 300 passengers. For the convenience of the latter, and to afford protection from the weather, there is a glazed shelter, with folding doors at either end and sides. On the top of the car will be placed the engineer's cabin, containing controlling levers and switchboard, so that he will have a complete uninterrupted view of the course, and the car at all times completely under his control. Reverse and forward gearing are to be provided, so that the car can be driven in either direction as desired at a moment's notice, or if the exigencies so demand it, the engineer can stop the car very quickly by means of the brakes. The time occupied in crossing from one side of the river to the other will be about 2¼ minutes, which is equivalent to a traveling speed of about 444½ feet per minute. Including time for unloading and loading, it is anticipated that nine or ten trips per hour will be made.

The car is to be propelled by electric traction. The rails upon which the trolley is to run are fixed upon the lower flange of the stiffening girders. The trolley is 77 feet in length, and is carried upon 32 wheels, 16 on each side. It is to be propelled by two electric motors each developing 35 brake horse-power. This is more power than will be necessary for actually driving the car; but the high power has been adopted to enable any sudden emergency, such as a strong head wind against a heavy load, to be coped with, and furthermore to effect economy in working. The motors are attached to a kind of bogie arrangement in the trolley, so that in event of large curvature of the bottom boom of the stiffening girders, arising either from temperature or load, the driving wheels will still be able to secure a firm grip upon the track metals. Automatic and hand brakes are provided, and it will be possible to bring the car to a standstill, even when traveling at full speed, within its own length.

The engineers for the work are Messrs. John J. Webster, M. I. C. E., of London, and John T. Wood, M. I. C. E., of Liverpool, to whom we are indebted for the accompanying illustrations. The total cost of the structure will approximate $650,000, which is about one-third of what a high-level suspension bridge would have cost.

A series of experiments have been conducted at St. Petersburg before a number of the court officials with a new cuirass invented by an Italian named Giorgiano, which it is claimed is impenetrable to revolver bullets, and resists steel onslaughts, such as are inflicted by a sword or bayonet. The breastplate is made of soft, elastic material, is about a centimeter in thickness and weighs four pounds. The experiment included the discharge of shots at eight planks, each an inch thick, and placed one on top of the other. The shots penetrated every plank. Then a sheet of steel, two inches in thickness, was pierced by the shots. Bullets were fired from a long-range heavy Russian cavalry revolver of the Nirwan type and a heavy American pattern revolver, respectively, but in each case the shots that were fired at the breastplate failed to penetrate or even dent the inner surface of the cuirass, remaining embedded. Even explosive bullets did not damage the breastplate. Experiments were also made with a steel bayonet, a Circassian dagger, and a sword of Damascus steel. The bayonet and the dagger broke without cutting the breastplate, while the saber simply made a dent on the outside of the fabric.

South Africa contributes about 95 per cent of the world's supply of diamonds, the trade being thus controlled by the De Beers Consolidated mines, which, in the year ending June 30, 1903, recovered 2,475,802 carats, valued at £5,241,173 ($25,507,042).

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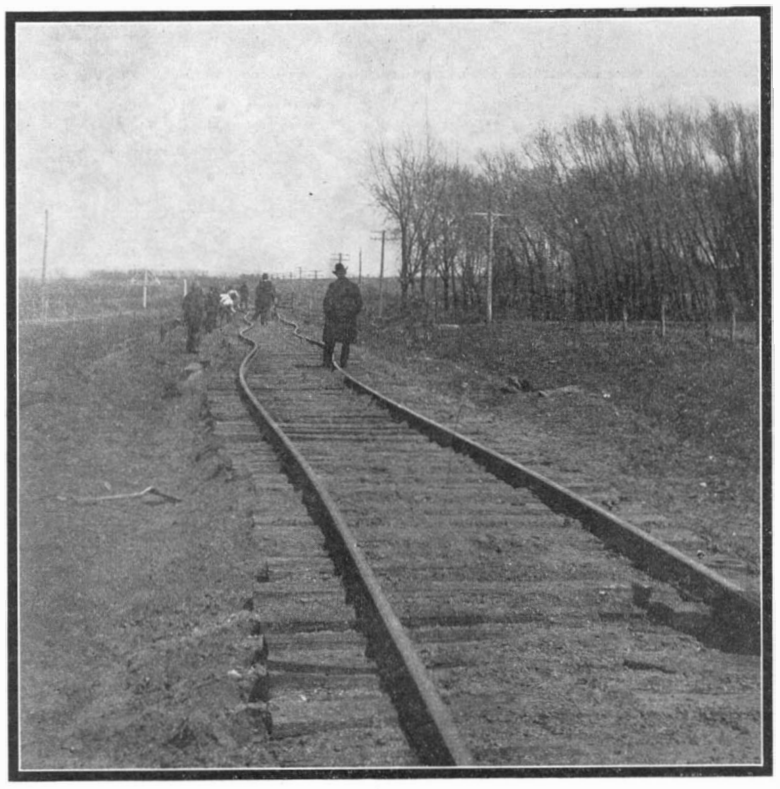
A BAD CASE OF WARPED RAILROAD TRACK.

The most extreme case of distortion of railroad track, due to changes of temperature, that ever came to our notice, is that which is shown in the accompanying illustration. It occurred on April 27, shortly after noon, at a point about three miles northeast of Waterloo, Iowa, on the Chicago & Great Western Railway, and it required no small amount of work on the part of the section gang to get the track back into such shape that the noon passenger train, which was stopped by the accident, was able to proceed.

The track, which was laid about two years ago, is at this point practically level, and the ties are laid in gravel and sand. Apparently there had been no very sudden change in temperature, the government readings giving 62 as the maximum temperature at Dubuque, Davenport, and Des Moines. The probable explanation is that there may have been a creeping of the track during the recent very cold weather, which caused a local closing up of the joints until the rail ends were in close contact; and that with the return of warm weather, the expansion of the rails caused the track to give way laterally at the spot where the resistance was least. It will probably be found that the resistance of the ballast to lateral displacement was considerably less on the stretch of track where the distortion took place, than for a considerable distance on either side of it. Railroad men are accustomed to distortions of the track due to temperature changes; but we think that the most experienced veteran will look upon this picture with no small amount of wonderment.



BAD CASE OF WARPED RAILROAD TRACK.

THE CYCLOGRAPH.

BY EMILE GUARINI.

The apparatus called a cyclograph, recently devised by Mr. Ferguson, is designed for the same purpose as the pedograph of the same inventor, that is to say, for automatically making a topographical record of the ground traversed during a journey. The new apparatus differs from its predecessor in that it is designed for the bicyclist, while the pedograph was designed for the pedestrian. It consists essentially of a flat box arranged horizontally upon the handle bar of the bicycle and containing a sheet of drawing paper, which, owing to the meridians that are traced upon it, may be kept constantly in position in the direction of the road according to the indications of a compass mounted upon the top of the box. As a result of the motion of the bicycle, the paper always moves backward in the direction of the longitudinal axis of the bicycle, and a small inked wheel rubbing over the paper inscribes a line upon it. If the bicyclist makes an angle upon the ground, he turns the paper (guiding himself by the indications of the compass) at an equal angle in the opposite direction. This is always done around a point situated beneath the marking wheel as a center. The paper immediately continues its motion backward as before. As a result there is marked upon the paper a line which exactly indicates the trip made. The motive power for actuating the cyclograph is obtained from a very simple eccentric arrangement fixed to the front wheel. A disk of thin steel, with an interior eccentric circle, is placed in the vicinity of the spokes of the wheel in such a way that it can revolve freely with the wheel without striking the fork. Upon the periphery of this disk slides a shoe forming part of a lever which is secured, in such a way that it can oscillate, to a small bracket projecting forward from the axis of the wheel outside of the fork. This arrangement may be seen in Fig. 1. When the apparatus is not in operation, the lever may be dropped out of contact with the disk. The apparatus may be easily started again by raising the lever until the shoe touches the edge of the disk.

Fig. 3 shows the manner in which the motive power thus produced is utilized in the apparatus. The horizontal lever, *A*, is capable of oscillating around the vertical shaft of the driving wheel, *B*, and striking alternately the posts, *C* and *D*. Of these latter, the first is stationary, and the second movable upon a graduated scale to which it may be secured by means of a thumb screw, *E*. In an inoperative position, the lever is held against *C* by the spring, *F*, which has sufficient strength to keep taut the wire, *W*, that runs to the eccentric. If a pull be given the wire, the lever will be moved until it strikes the post, *D*. The excess of power still exerted by the eccentric at this moment is absorbed by the spring, *G*. In this way, the lever is always limited to the amplitude of oscillation allowed by the adjustable post, and which ranges from zero to maximum, according to where the post is set. Upon each side of its fulcrum point the lever is provided with vertical flanges, *H*, which leave between them and the rim of the wheel, *B*, two oblique spaces in which the disks, *K*, are inserted in such a manner that they have a slight play. If the lever, *A*, moves toward *C*, the disks will slide with an imperceptible friction along the rim of *B*, in such a way that the rubbing spring, *L*, can only just maintain the wheel, *B*, in position. When the lever moves in the opposite direction, the small disks, *K*, become jammed between flanges, *H*, and the wheel, and thus turn it. The reason for this is that when the lever moves in one direction the disks, by rubbing against the wheel, are pushed into the widest space between the flange, *H*, and the wheel's periphery, while when the lever moves in the opposite direction they become jammed in the narrowing space between *H* and the wheel rim, thus moving the latter, as stated above. The result is that the various positions in which the post, *D*, is placed, will determine the amount of movement given the wheel at every revolution of the bicycle wheel, since each turn of this wheel produces an oscillation of the lever. The wheel, *B*, has a double-threaded worm, *M*, upon the upper end of its shaft, and this drives the small gear, *N*. The teeth of this gear project above the cover plate, *O*, through a slot in the latter. The paper is placed upon the plate, *O*, between the gear, *N*, and the inking wheel, *P*.

If, as a consequence of the oscillations of the lever, *A*, the gear wheel, *N*, begins to move, it will carry the paper along with it. The inking wheel will revolve and draw a line upon the upper surface of the paper, while the teeth of the gear wheel will leave their marks upon the lower surface. These marks will be spaced one millimeter apart. As every oscillation of the lever corresponds to one revolution of the wheel of the bicycle, and consequently to about 2.15 meters (7 feet) of the road, one millimeter upon the paper therefore represents as many times 2.15 meters upon the road as it has required oscillations of the lever, *A*, to cause the wheel, *B*, and the worm, *M*, to make only a revolution. The latter is double-threaded and moves gear, *N*, one tooth for every half revolution that it makes. The scale may therefore be established at will for any value from one ten-millionth up to $1/\infty$.

In order to prevent displacement of the paper, the apparatus is completed by the arrangement *U T A′ V*, which serves at the same time to turn the paper at a certain angle. *U* is a rod provided with a grip, by means of which the arrangement is actuated; *T* is the prolongation of the rod; *A′* a milled wheel mounted upon a spring that plays the part of a flexible shaft; and *V* is another roller, which presses the paper against *A′* which projects through a slot in the plate *O*. If the route is north-south, the paper will be moved regularly backward; but if the road turns, the bicyclist turns the paper at the same angle by means of the arrangement just described and as indicated by his compass.

In order to do away with the inconveniences inherent in

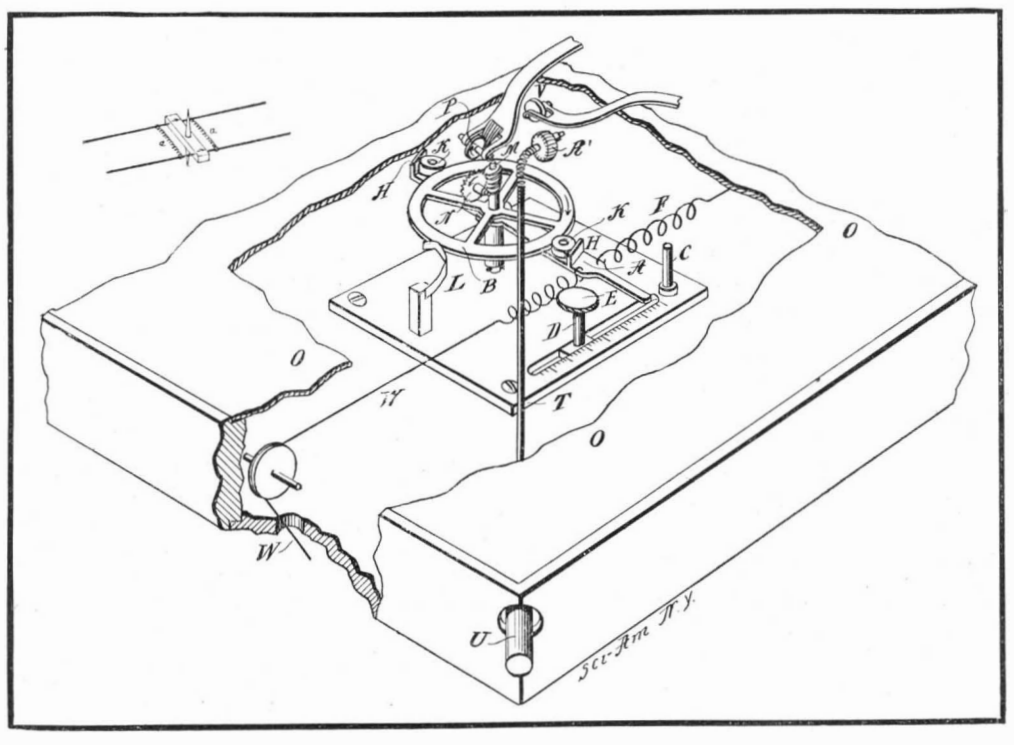


Fig. 3.—DETAILS OF THE MECHANISM OF THE CYCLOGRAPH.

Fig. 1.—THE CYCLOGRAPH ON A BICYCLE.

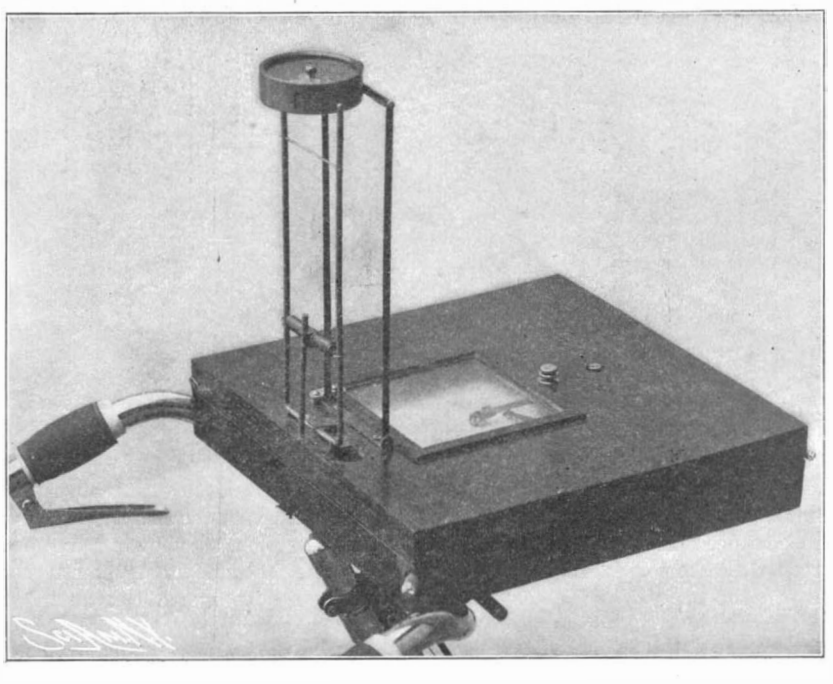


Fig. 2.—THE FERGUSON CYCLOGRAPH.

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its use, the compass is constructed so as to assure its needle a magnetic moment as great as possible, and a moment of inertia as small as possible. For this purpose, the compass is arranged as shown in Fig. 4. Two steel needles are fixed to a small piece of wood through which passes the vertical axis. Two small springs, *a*, serve to regulate the equilibrium. The two points of the axis move in agate bearings. The bottom and cover of the compass are of glass so as to permit the rider to see through it the meridians previously inscribed upon the paper and to keep them parallel with the needle. This manipulation is effected by means of the arrangement *U T S R* (Fig. 3) already described. The compass is placed about 10 inches above the box in order to protect it against the magnetic effects of the rolling machine.

In order to avoid vibrations, the compass is mounted upon a rectangular frame of strong copper wire (Figs. 1 and 2) fixed by a hinge to the cover of the box, upon which it can be turned down. The compass is capable of revolving upon this frame, and it is held by two independent rods parallel with the surface of the box. The vibrations are thus subdivided and absorbed by eight movable and elastic parts.

In the experiments that were made with the apparatus, the results were such that it was scarcely possible to distinguish the lines thus obtained from those found upon an official map. So before the apparatus was put upon the market, a sample was ordered by the Intelligence Branch of the English government with a view to utilizing it in China, the topography of which country has been but slightly studied, although the country is provided with good roads. In all countries of this kind, the Ferguson cyclograph will certainly be of great value.

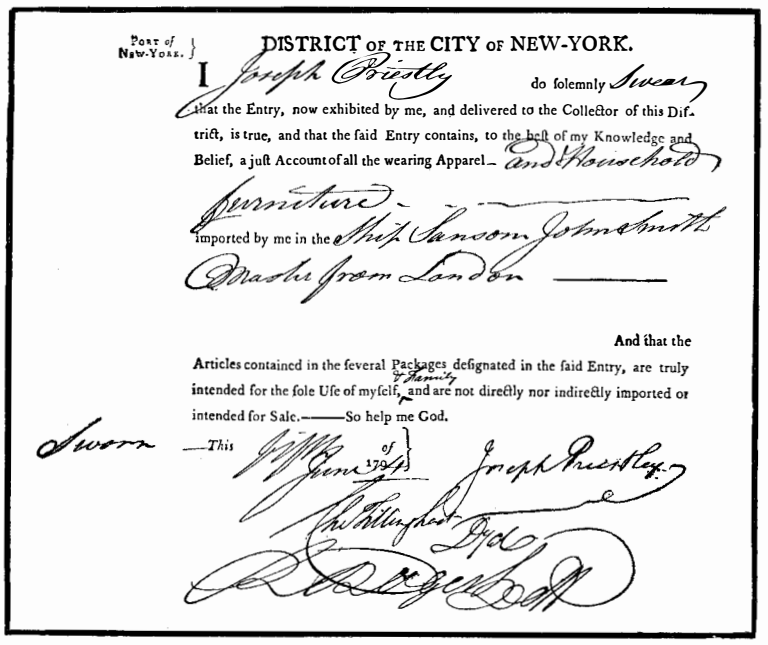
FACSIMILE OF DR. JOSEPH PRIESTLEY'S INVOICE ON COMING TO AMERICA IN 1794.

BY GEORGE F. KUNZ, PH.D.

These valuable documents were recovered from a mass of old papers, many tons in weight, containing thousands of signatures of men noted in local and national history, that was sold for waste paper in connection with the coming removal of the New York Custom House to its new site near the Battery. Their value was suspected, and the New York Scenic and Historic Preservation Society made many efforts to prevent their disposal in such a manner, but without avail.

Dr. Joseph Priestley, whose name is forever associated with the discovery of oxygen, was born near Leeds, England, in 1733. His great discovery was foreshadowed in a paper on the properties of the "different kinds of air," published in the Philosophical Transactions of the Royal Society in 1773. It received the Copley medal, as a communication of great importance, but its full significance was by no means understood. The next year, 1774, is usually given as the date of the actual discovery of oxygen gas, which he termed "vital air," or "dephlogisticated air," but never appreciated its real character. This was recognized and determined some fifteen years later by Lavoisier; but Priestley himself remained all his life a believer in the old theory of "phlogiston."

Dr. Priestley was a dissenting minister, but developed a growing tendency toward Socinian views in theology and liberal doctrines in politics. He was always much interested also in philosophical and scientific studies. After holding several positions, as pastor of churches, tutor in Warrington Academy, and scientific librarian to the Earl of Shelburne, he took charge of a church in Birmingham. When the great agitation connected with the French revolution came on, he was suspected of sympathizing with it, on account of the advanced liberalism of his general views. Public excitement ran very high on that subject; and in 1791, on the occasion of a celebration at Birmingham of the storming of the Bastile, although Dr. Priestley was away, his house was attacked and burned by a mob, and his library and apparatus destroyed. After three years spent at Hackney, largely in scientific pursuits, he decided to come to America, where he had sons living at Northumberland, Penn. He reached New York in June, 1794; and the writer has in his possession the original inventory, from which the illustrations were made, in Priestley's own handwriting, of the goods and furniture which he brought over with him, in the ship "Sansom," Capt. John Smith, as also his affidavit, signed by him and by William Tillinghast,


Port of New-York. } DISTRICT OF THE CITY OF NEW-YORK.

I Joseph Priestley do solemnly Swear that the Entry, now exhibited by me, and delivered to the Collector of this District, is true, and that the said Entry contains, to the best of my Knowledge and Belief, a just Account of all the wearing Apparel — and Household Furniture — imported by me in the Ship Sansom John Smith Master from London —

And that the Articles contained in the several Packages designated in the said Entry, are truly intended for the sole Use of myself & Family, and are not directly nor indirectly imported or intended for Sale. — So help me God.

Sworn — This 3d of June 1794 — Joseph Priestley

JOSEPH PRIESTLEY'S CUSTOMS ENTRY, 1794.

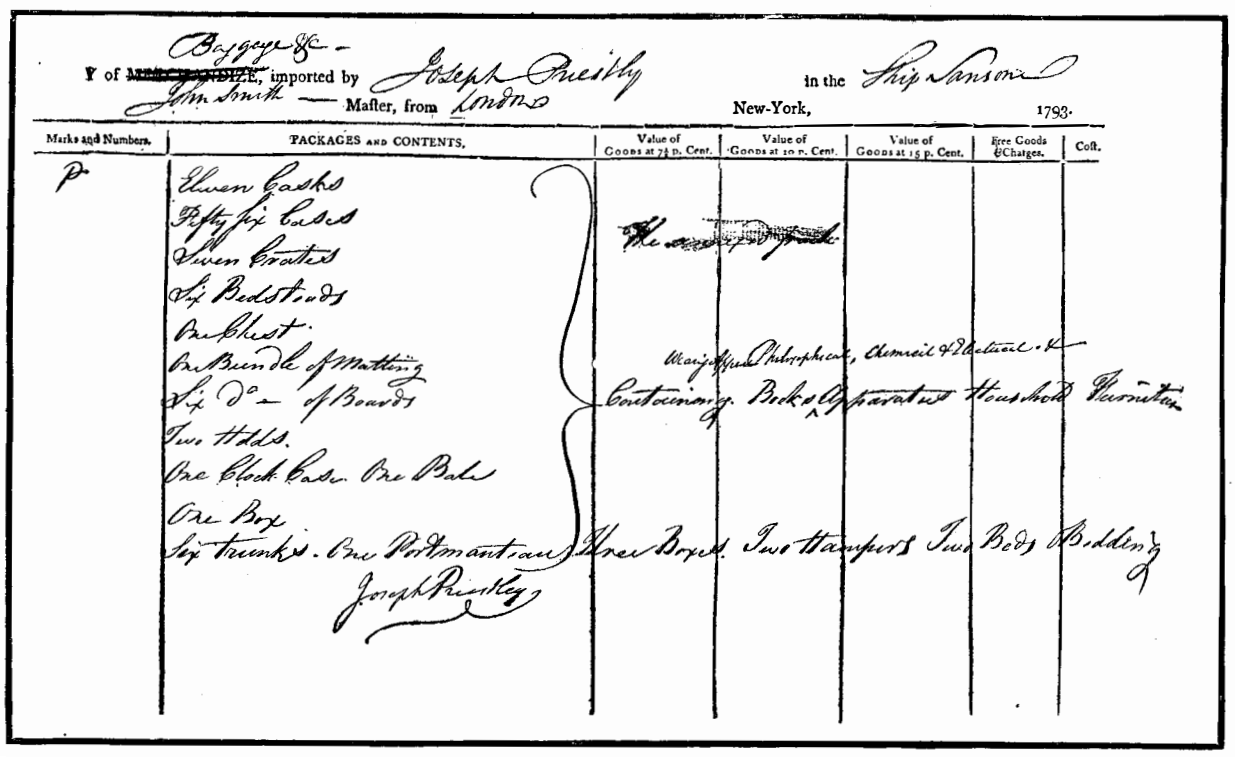
deputy collector of the port, declaring that "the articles contained in the several packages designated in this entry are truly intended for the sole use of myself and family, and are not directly or indirectly imported or intended for sale."

The list, it will be seen, is a pretty extensive one, comprising the furnishings of a large home as well as a laboratory. It is as follows: Eleven casks, fifty-six cases, seven crates, six bedsteads, one chest, one bundle of matting, six dozen of boards, two hogsheads, one clock case, one bale, one box, six trunks, one portmanteau, containing books, wearing apparel, philosophical, chemical, and electrical apparatus, household furniture, three boxes, two hampers, two beds and bedding. [Signed.] Joseph Priestley.

The remaining ten years of his life were passed at Northumberland, Penn., with his sons and family, and were occupied chiefly in his favorite scientific studies. He died in February, 1804, at the age of seventy-one.

In 1874 the chemists of America celebrated the hundredth anniversary of his discovery of oxygen, by a notable gathering at Northumberland, Penn., under the name of the Centennial of Chemistry. Dr. Priestley's descendants are still living there, and greatly revere his memory. Much of his old furniture and apparatus are preserved, the latter very interesting, not only historically, but as showing the simple, and, in many cases, home-made instruments with which a great student and observer did great and pioneer work in chemical research.

In the Kunz collection of scientific portraits and relics of eminent men of science, now in the Field Columbian Museum at Chicago, there is a letter from Dr. Priestley to a friend in England, in which he says that if he had known how cheaply and comfortably he could have lived in France, he would never have come to America. This letter was published, along with a number of others from and relating to Priestley, by Dr. H. Carrington Bolton in a volume a few years since.


Baggage &c — Entry of [illegible], imported by Joseph Priestley in the Ship Sansom John Smith — Master, from London New-York, 1793.

Marks and Numbers.	PACKAGES AND CONTENTS.	Value of Goods at 7½ p. Cent.	Value of Goods at 10 p. Cent.	Value of Goods at 15 p. Cent.	Free Goods & Charges.	Cost.
P.	Eleven Casks					
	Fifty six Cases					
	Seven Crates					
	Six Bedsteads					
	One Chest.					
	One Bundle of Matting					
	Six Do — of Boards					
	Two Hdds.					
	One Clock Case. One Bale					
	One Box					
	Six Trunks. One Portmanteau					

Joseph Priestley

Maiz. Apparatus Philosophical, Chemical & Electrical &c. &c. Containing Books & Apparatus Household Furniture

Three Boxes. Two Hampers Two Beds & Bedding

MANIFEST OF JOSEPH PRIESTLEY'S GOODS IN SHIP "SANSOM."

The Electric Organ of the Torpedo Fish.

In a paper recently read before the Berlin Academy of Sciences, J. Bernstein and A. Tschermak investigate the thermic phenomena shown by the electric organ of the torpedo or electric ray. Such physiological researches as have so far been made in this direction were intended merely to ascertain the intensity, direction, and duration of the electric shocks. It is safe to say that the electric discharges operative here have been found to consist of individual, short-lasting impulses, which always follow the same direction. The elements constituting the batteries of which the organ is made up, will assume a negative potential on the side where the nerve fiber enters the organ. As regards, however, the causes to which are due the potential differences produced in these elements, the investigations made up to this day were not able to afford any likely explication. Now, according to the recent thermo-dynamic theories of galvanic batteries, exothermic batteries (being heated during operation) should be distinguished from endothermic batteries, which, in the course of working, will undergo a cooling effect. Whereas, the E. M. F. of the former class of batteries is lowered with increasing temperatures, that of the latter class is found to increase. The authors made the following experiments for the most part in the Naples Zoological station. In order to determine the variations of temperature undergone by the electric organ of the fishes, they used Constantan batteries, consisting of ten to twenty elements, made up of plates or wires of iron and of this alloy (Constantan is an alloy of copper and of nickel containing 50 per cent of each), which were dipped in the dissected organ, or else introduced between the two organs of the same fish, while being in connection with an extremely sensitive Rubens galvanometer. The organ was stimulated from the nerve by means of currents from an induction coil, acting in most cases for one second. As it was impossible to evaluate the electric energy of the discharge by means of the electrodynamometer electric method, the authors determined the amount of heat evolved in the external circuit by means of an air thermometer analogous to the Riess thermometer. From these experiments, the remarkable result is inferred that the variations of temperature undergone by the stimulated organ are so small as to be inappreciable. The electric organ, accordingly, shows a thermic behavior essentially different from that of muscles. It cannot therefore be analogous to a battery working exothermically with a considerable evolution of chemical heat. It rather seems likely to constitute an endothermic battery, and, more especially, a concentration battery. With respect to the thermic behavior, it resembles a nervous tissue rather than a muscular tissue. These researches are further confirmed by experiments made with a view of finding the temperature coefficient of the power of the shocks.

Both of the two schemes for an electric high-speed railway between Berlin and Hamburg, lately presented to the Prussian railway department, provide for an electric central station to be installed in Wittenberg, the main station between Berlin and Hamburg. It is anticipated that the journey between the two cities, which at present requires upward of three hours with the fastest trains, will eventually be made in one and one-half hours only. As a matter of course, a new roadbed will be necessary, but the cost of this reconstruction does not seem to be prohibitory. The fact that a third track has been found necessary (which in the case of the electric high-speed railway being installed could evidently be dispensed with) is illustrative of the dense traffic existing between the two largest German cities.

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THE MOTHER OF EXHIBITIONS.

(*Continued from page* 419.)

this festival of amity. In all parts of England itself the exhibition aroused intense enthusiasm as long as it remained open. One reads, for example, of an old Cornish woman who had trudged on foot three hundred miles from her native county to see the wonderful palace of glass. The feeling of London showed itself at a ball given in the Guildhall, when the passage of the Queen and the Prince Consort through the city was made the occasion of the most jubilant demonstrations of loyalty, even on the return journey, though it was as late as one o'clock in the morning.

On October 15 the Prince Consort declared the exhibition closed, and the awards were published. The fair had been divided into four great departments—raw materials, machinery, manufactures, and fine arts—and these were subdivided into thirty classes. One-half the space had been allotted to England and the colonies, and one-half to foreign countries. There were 17,000 exhibitors, of whom 2,918 received prize medals and 170 council medals. The estimated value of the articles exhibited, exclusive of the Kohinoor diamond, was $8,909,645. During the 144 days during which the exhibition was open, there was a total of 6,170,000 visitors. The largest number entering in one day was 109,760 (on October 8), and the largest number present at one time was 93,000 (at 2 o'clock on October 7). Haydn's "Dictionary of Dates" is responsible for the statement that the latter is the largest number of persons recorded in history to have ever been present at one time in one room, though larger crowds have assembled simultaneously in the various buildings of other exhibitions and in the open air.

Long before the final accounts came to be made up, it was evident that there would be no tax upon the guarantors. The amount paid for admission was $2,525,535. After all expenses had been met, this left a surplus of $1,066,525. There was much discussion as to what should be done with it, for such a result was so unexpected that no provision had been made for it in the original scheme. Some advocated that it should be spent upon a winter garden; but others, notably the Prince Consort, thought it would be an anti-climax to connect with a mere place of amusement the memory of an exhibition which had been a landmark in the history of industrial art. The wiser counsel prevailed, and the money went to form the nucleus of what was afterward known as the South Kensington Museum, an institution which has been not only a permanent collection of valuable exhibits, but a center of artistic and scientific education throughout the British Isles.

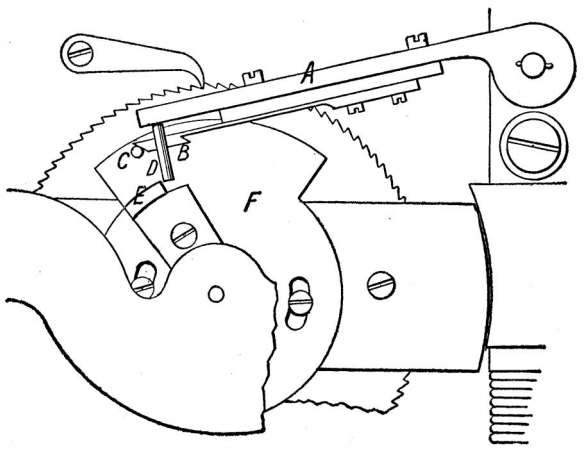
And what was to happen to the actual building? Some who had at first vehemently opposed the desecration of Hyde Park by any such monstrosity, were now eager that it should remain forever where it was. This plan, however, was not generally thought to be expedient. On December 1 the building was surrendered to the contractors, who sold the materials for $350,000 to a company which proceeded to re-erect it on the top of a hill in the suburb of Sydenham. The services of Paxton, who had received the well-deserved distinction of knighthood, were brought again into requisition, but this time the work was carried out in more leisurely fashion, for it was not until June 10, 1854, that the transplanted building was opened on its new site. From that time until the present the "Crystal Palace," as it came to be called, has been well known to every Londoner and every visitor from the country. It has been especially noted for its musical festivals, and has many times recalled the memories of its original function by affording a home for exhibitions, generally of some special scope, as bicycle shows, chrysanthemum shows, etc. A notable occasion was a service held on the fast day for the Indian Mutiny, when Mr. Spurgeon preached to a congregation of 23,000 people.

In cost, size, and number of visitors the exhibition of 1851, though spoken of at the time as "the Great Exhibition," appears small in comparison with such an enterprise as the St. Louis Fair. But no successes of later undertakings in the same line can rob the promoters of the Hyde Park project of the distinction that belongs to the pioneer. On the other hand, the very expansion of the international exhibition movement is itself the greatest possible tribute to the wisdom and courage of those who made the strange idea familiar. And, as Mr. Justin McCarthy has put it in his account of the event in the "History of Our Own Times," although later exhibitions have been far superior, "the impression which the Hyde Park Exhibition made upon the ordinary mind was like that of the boy's first visit to the play—an impression never to be equaled, no matter by what far superior charm of spectacle it may in after years again and again be followed."

The largest producer of sulphur is Sicily; its deposits occur in Miocene limestone, with unaltered beds of gypsum below, and it exported in 1903 475,508 tons, of which nearly one-third was for the United States.

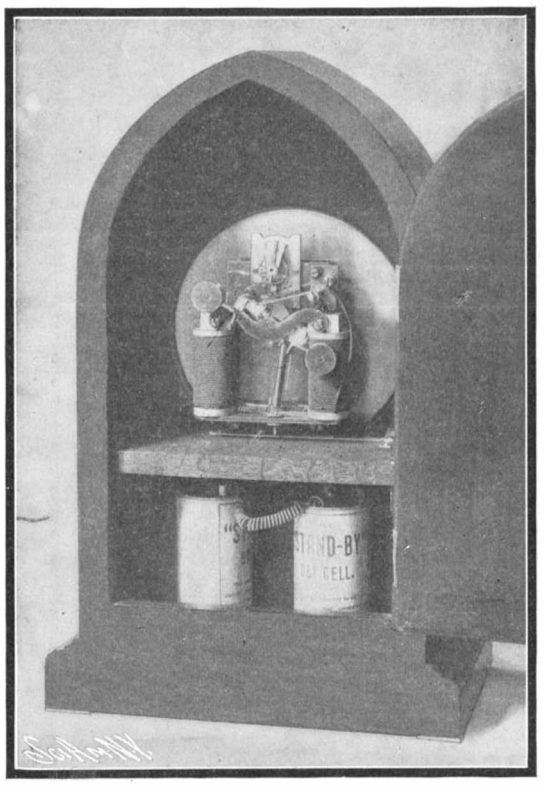
AN ELECTRICALLY-OPERATED CLOCK.

It is the usual practice in clocks driven or wound by electricity to arrange the pendulum to make the electric contact at regular intervals; but heretofore great difficulty has been found in keeping the contact points bright and clean, owing to excessive sparking on breaking the circuit. The clock which we illustrate herewith is so designed as to entirely overcome this defect, and, furthermore, is so constructed as to reduce friction of the parts to a minimum—a prime requisite in all electric clocks. As a result of embodying these two features in this movement, but little current is required to operate it, two small dry cells being amply sufficient to keep the clock running for three years without renewal. The improved electric clock comprises an electro-magnet, between the poles of which



POSITIVE CONTACT FOR ELECTRIC CLOCK.

an armature is pivoted to swing. A pawl attached to this armature engages a ratchet wheel connected with the gear train of the clock, and a spiral spring attached to the armature near one end serves to draw it slowly out of line with the magnet poles, thus operating the clock movement. The latter may be regulated either by a balance wheel or a pendulum escapement, as desired. Electric contact is made at the end of every six minutes, the current serving to energize the magnet and draw the armature back to horizontal position against the tension of the spiral spring. The contact is made by means of a very efficient arrangement which is shown in our detail view. One terminal, *E*, consists of a metal segment which is carried on a plate, *F*, secured to the armature. The other terminal, *D*, consists of a pin which is secured to a swinging arm, *A*. Fastened to this arm, but insulated therefrom, is a flat spring provided at its free end with a



CLOCK WOUND EVERY SIX MINUTES BY ELECTRICITY.

head or cam, *B*, adapted to engage a pin, *C*, on the plate, *F*. The ends of the cam, *B*, are beveled, as illustrated, so that when the armature moves away from the poles, the cam will ride over the pin, *C*, lifting the contact pin, *D*, out of engagement with the segment, *E*. When the pin, *C*, passes the inner end of the cam, the pin, *D*, will drop onto the segment, *B*, completing the circuit through the magnet coils and causing the armature to swing back, and the cam then riding under the pin, *C*, will press the terminal, *D*, down against the segment, *E*, insuring a perfect contact. During the fraction of a second which is taken up by the armature in swinging to horizontal position, the clock movement is actuated by a second spring, not shown in our illustration, which is put under tension by the movement of the armature. The striking mechanism of the clock is actuated by another spring which is wound up by the movement of the clock hands. The form of the main spring, that which acts on the armature, is quite novel in construction. Due to its spiral form it does not lose its elasticity as rapidly as the usual type of clock spring, particularly since its extension is very slight compared to its length. By means of a thumb-screw adjustment at its lower end, its tension may be very accurately regulated. Mr. Max Moeller, of 73 Palmaille, Altona, Elbe, Germany, owns the patents on this improved electric clock.

The Scientific American in the Schools.

It is pleasing to know that the SCIENTIFIC AMERICAN is widely read in schools. We have recently been favored with a circular issued by the Superintendent of the Whitinsville, Mass., schools, which says: "A friend of the schools has been gratified at finding the names of so many pupils on the honor roll for the past year. He most thoroughly believes that one of the best lessons to be learned in the schools is that of punctuality and regularity; after the habit of honesty and truthfulness in word and deed, and earnestness and thoroughness in doing, no habit of greater value can be formed in youth than that of fulfilling our duty at the appointed time. In recognition of your faithful attention to this duty of regular attendance, a year's subscription to your choice of one of the periodicals named on the inclosed card will be sent you if you will mark, sign, and return the card." One of these circulars was sent to every pupil on the honor roll. It is gratifying to note that ten of the pupils selected the SCIENTIFIC AMERICAN in place of papers which deal with lighter subjects. The SCIENTIFIC AMERICAN should find its way into every schoolroom.

The Current Supplement.

Two striking pictures with a brief article on the Craig-Goch Dam, Birmingham, England, open the current SUPPLEMENT, No. 1482. Rear Admiral John Lowe presents a solution of the problem of the screw propeller which will doubtless be of interest to naval engineers. "Oil from Livers of the Cod and Related Species" is the title of a treatise by Charles H. Stevenson, whose articles on the fish industry of this country will doubtless be remembered by readers of the SUPPLEMENT. The English correspondent of the SCIENTIFIC AMERICAN describes in a very exhaustive manner the method by which the Duddell oscillograph records alternating-current wave-forms. The recent architectural discoveries at Pompeii are made the subject of an interesting account. To those who are not familiar with the fine instincts of animals, an article entitled "How Animals Detect Poison" will give a vast amount of information. Dr. R. V. Wagner describes an X-ray tube with adjustable focus. The usual engineering notes, electrical notes and trade suggestions from United States consuls are also to be found in the SUPPLEMENT.

Engineering Notes.

Another step in the direction of technical education has been made in the city of Dresden in the establishment of a school for locomotive driver apprentices. The initiative was taken by the Locomotive Drivers' Association of Saxony, which succeeded in interesting the members of the Dresden city council in the scheme, as well as the directors of the technical school and the administration of the Royal State Railroads. The purpose of the new school, which is managed in connection with the Dresden Technical School, is to better equip men who are to become locomotive drivers. The school is for apprentices between 25 and 30 years of age who are employed in the Dresden car shops. Among the subjects taught are German, arithmetic, graphics, and the mechanism of locomotives. For the present the course has been fixed for one year. The lectures and class-room work will be held on three evenings during the week and on Sunday mornings.

An important alteration has been made in the armament of the six armored cruisers of the improved County class, now in course of construction for the British Admiralty. Heavier guns than those originally designed are to be supplied, the alteration representing an increased outlay of $1,000,000 for the six vessels. The original armament for each of these vessels comprised fourteen 6-inch guns; but when Mr. Watts succeeded to the office of Chief Constructor of the Navy, two 7.5-inch guns were substituted for four of the 6-inch guns. In this last revision four more of the 6-inch guns are to be dispensed with, and in their place two 7.5-inch weapons are to be installed. Thus four 7.5-inch and six 6-inch guns will be carried. The 7.5-inch guns will be mounted as follows: One placed forward in a turret, and another aft. The other two will be in casemates, firing ahead or on the broadside. Thus three 7.5-inch weapons will fire ahead, and as many on the broadside. By this change the battery will be considerably strengthened and improved, for the 7.5-inch gun fires a 200-pound shell, as against the 6-inch gun's 100-pound shell, and will perforate a much greater thickness of armor.

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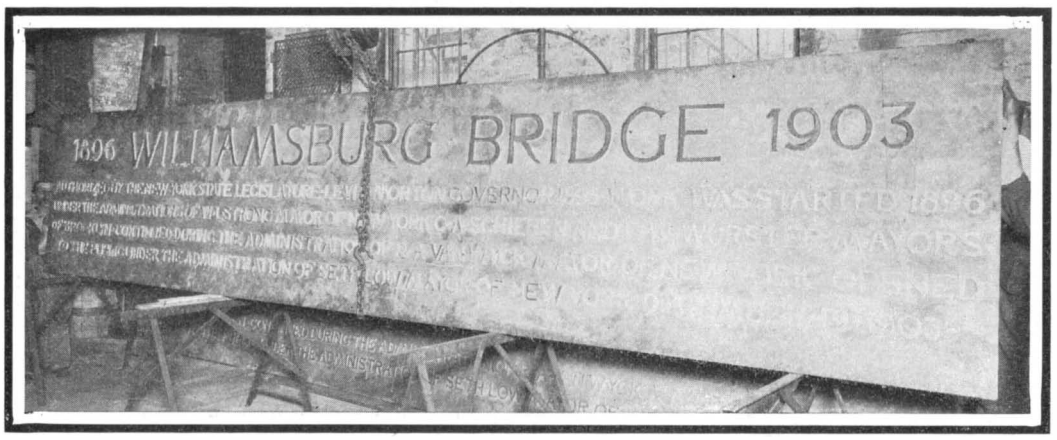
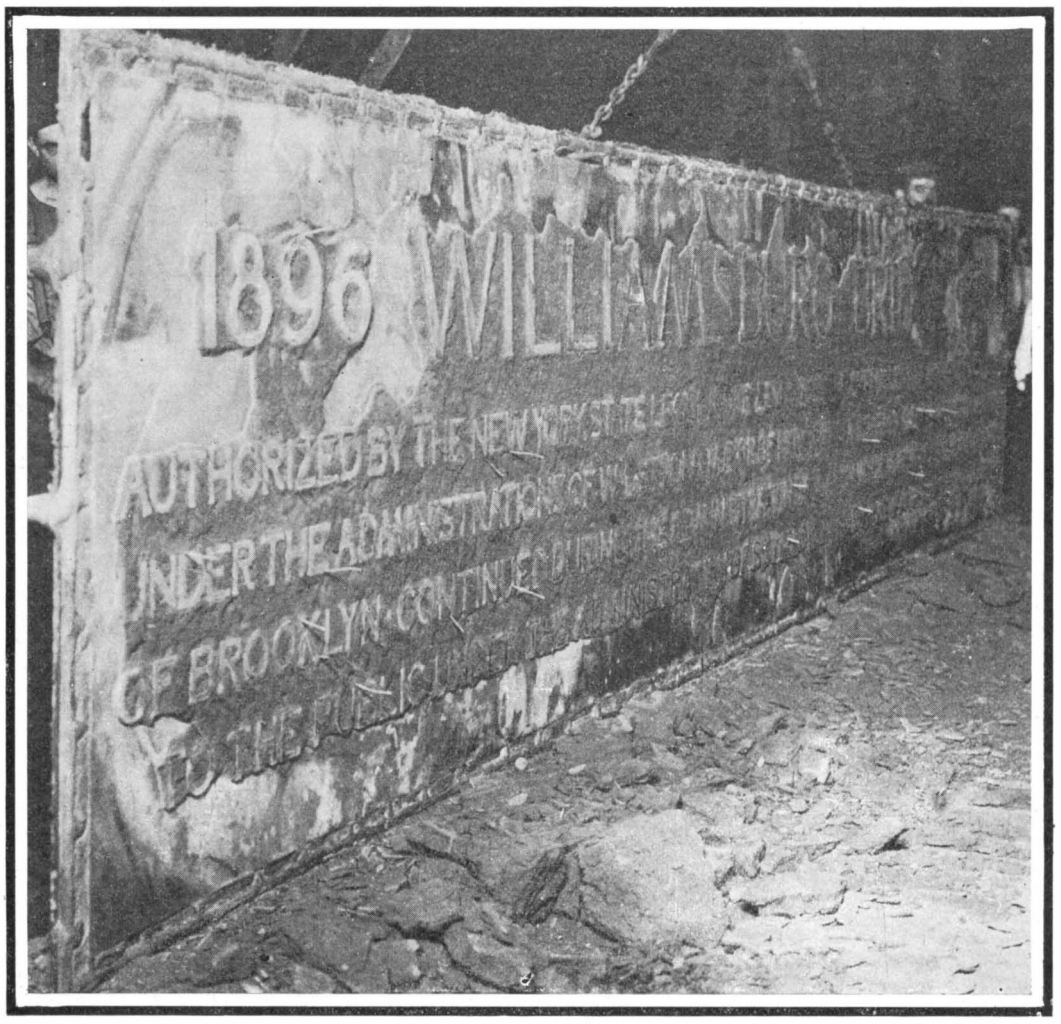
THE CASTING OF THE WILLIAMSBURG BBIDGE ENTABLATURES—A NOTABLE TECHNICAL ACHIEVEMENT.

The thousands of foot passengers who, in the near future, will walk beneath the great entablatures of the Williamsburg Bridge, on which the history of that structure is briefly emblazoned in letters of bronze, will probably never realize that, like the bridge itself, the great plates represent a technical achievement that is without a parallel in this world. No new process was employed in casting these expansive sheets of bronze; and still they are noteworthy for the fact that never before have plates of such great area and comparative thinness been successfully cast in one piece. For the details that we are enabled to present of the making of the entablatures we are indebted to Mr. S. U. Barr, of the William H. Jackson Company, at whose New York foundry, 229-239 W. 28th Street, the work was carried out.

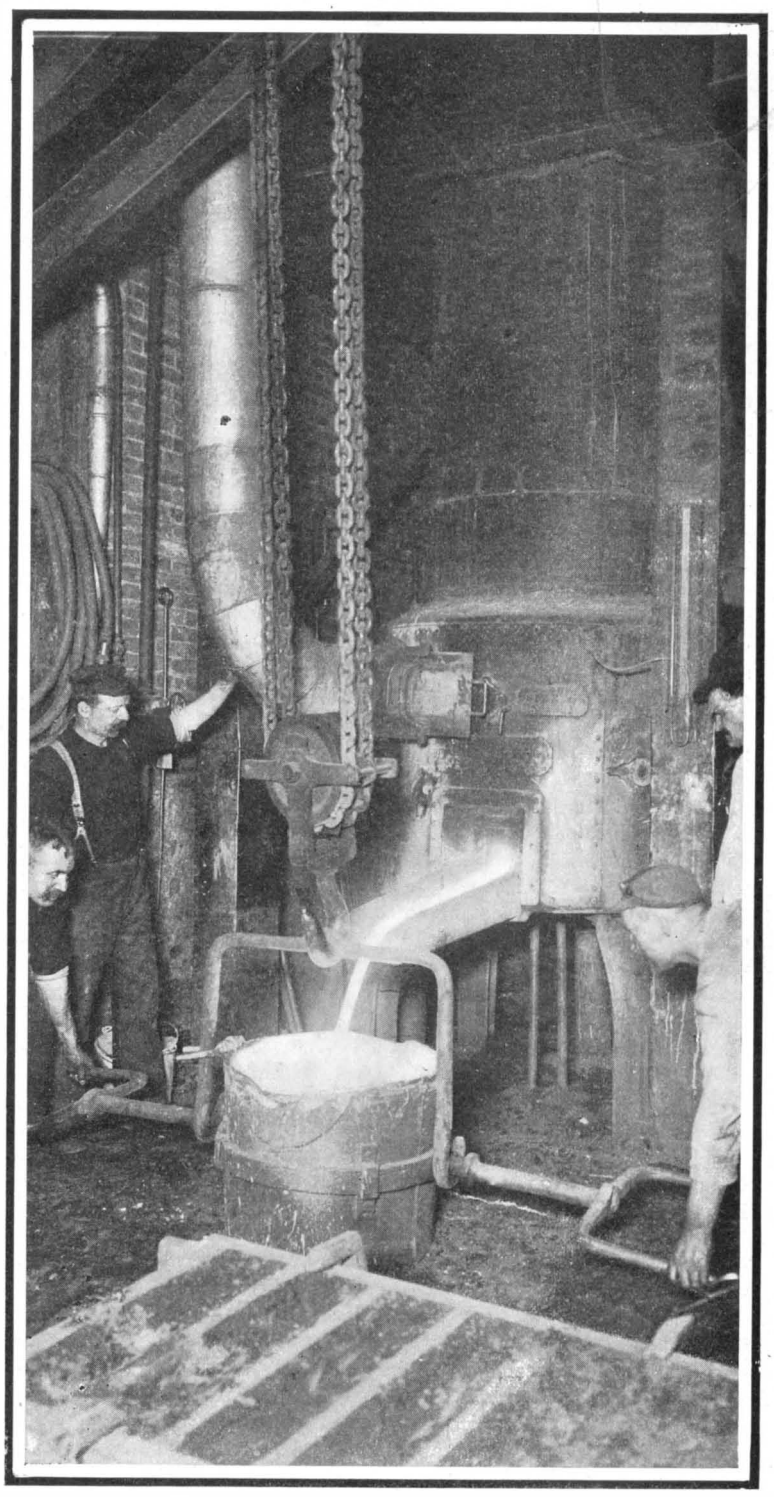
When it is considered that each of the two tablets has a total length of 52 feet 7 inches, a width of 4 feet 3 inches, and a weight of three tons, and the great



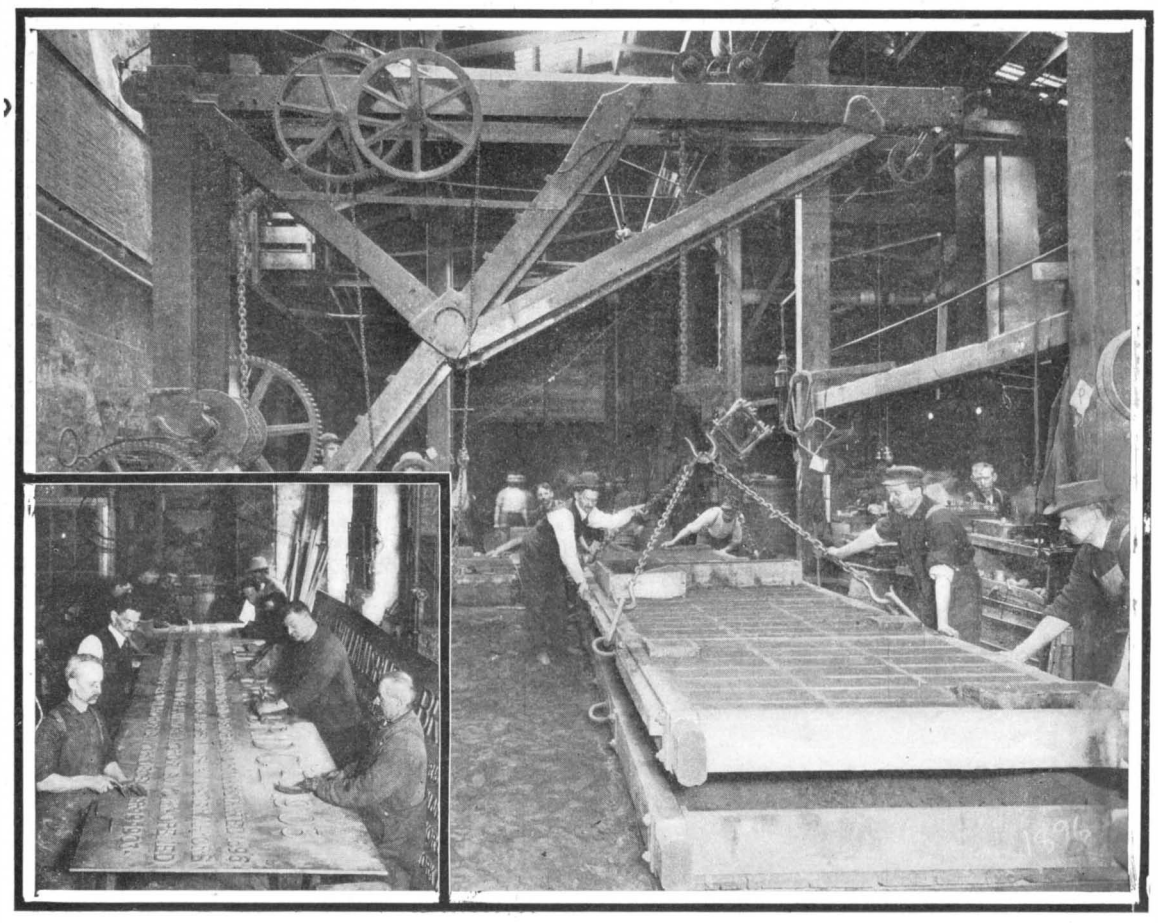
One of the Bronze Castings After the Sand Had Been Cleaned from the Surface.



The Casting as it Appeared When Lifted from the Sand Mold.

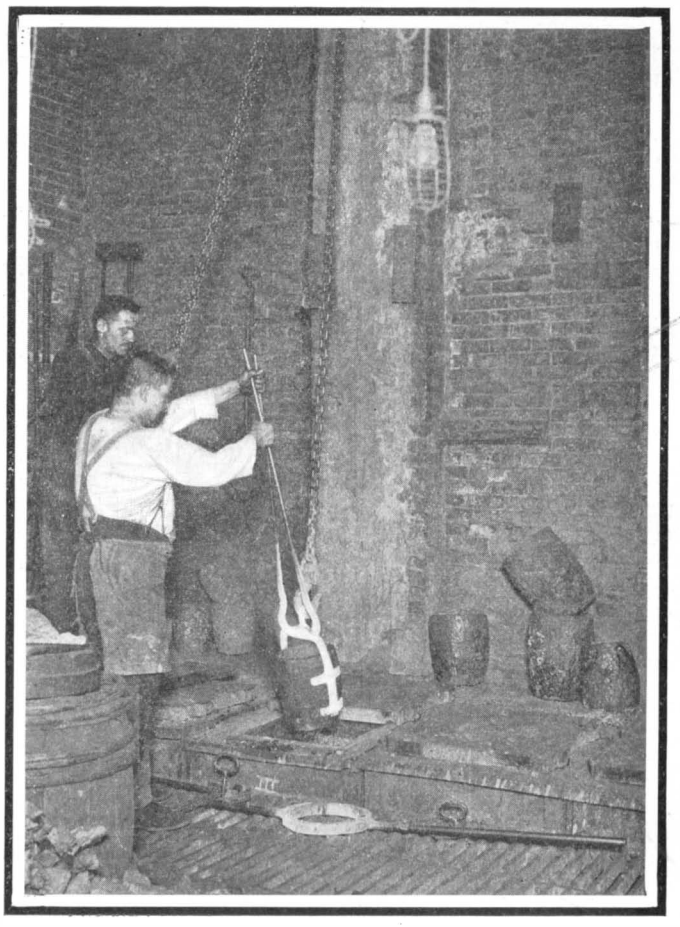


The Molten Bronze Metal Flowing from the Cupola.



Workmen Cleaning Up and Finishing the Surfaces of the Letters.

Closing the Mold Before Casting.



The Ordinary Bronze Furnace for Melting Bronze in Crucibles.

THE CASTING OF THE WILLIAMSBURG BRIDGE ENTABLATURES.

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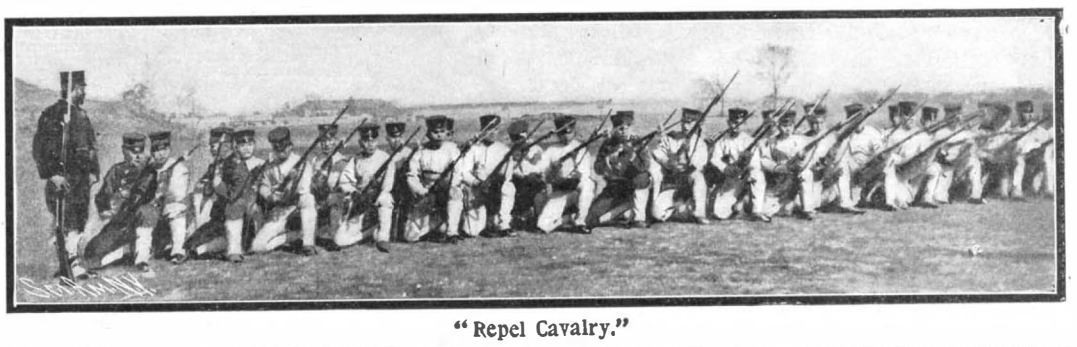
rapidity with which molten metal cools when poured over a large surface in a thin layer, some idea of the difficulty that was presented may be gleaned. The entire tablets are made up in three pieces with center and two end sections. The center sections are now cast and are 22 feet by 4 feet 3 inches. Since the total thickness of each tablet was to be only ⅜ of an inch, the nice problem of making a wooden pattern that could be readily handled without warping was presented for solution. Special kiln-dried wood was employed. The letters forming the inscription, varying in height from 3 to 9 inches, were fashioned separately and glued in place. The extent of surface was such that the pattern was made in three sections. of an inch thick. The metal as it ran into the mold seemed bound to chill as it came into contact with the cold sand before it had spread over the entire surface to be covered, and to leave holes and other imperfections in the casting. It was therefore necessary to devise some means of running the metal into the mold so that it would fill every part, before there was time for it to chill. The desired end was attained by pouring the metal into the flask simultaneously at seven different holes, so that it first filled a trough which surrounded the entire mold and from which the metal ran into the mold through 125 connecting passages or "gates" as they are called. Twelve hundred pounds of metal were poured into the trough from a ladle, held 12,000 pounds, was effected by means of the crane which had been previously used in pouring the 1,200 pounds of bronze already mentioned.

The preparation of these castings, the largest of their kind in the world, may well be considered a praiseworthy metallurgical achievement, of which the makers are justly proud; and the tablets themselves, a fitting tribute to the men whose energy gave us the new bridge.

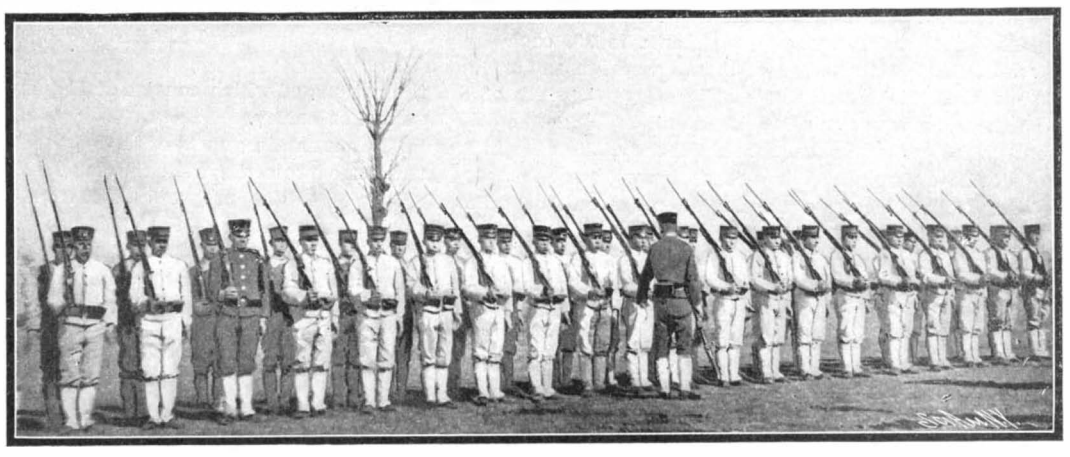
THE JAPANESE ARMY AND ITS GUNS.

The effective strength of the Japanese army has doubled during the period between the war with China and the present one with Russia. According to the present law, all male subjects between the ages of seventeen and forty are liable to service either in the army or the navy. The army, which has been organized by German officers, is divided into the active, or standing army, the reserve, the landwehr, depot, and the landstrum. The period of service in the active army is three years, and it is levied from able-bodied youths twenty years of age. After service in the active army a term of four years and four months is required in the reserve. The landwehr is made up of those who have completed their term in the standing army, and in this branch of the servise they are required to serve five years. The depot is divided into two classes—the first depot, composed of those who have not served in the active army and the term being seven years and four months, and the second

In the Trenches.



"Repel Cavalry."



Infantry at Drill.

Hauling Baggage to the Troop Trains.

Third Regiment, Imperial Guards.

Infantry Heavy Marching Order.

JAPANESE ARMY VIEWS.

The melting and mixing of the great quantity of metal required in the casting operation was no easy matter. The novel plan was adopted of first melting the copper and other metals in crucibles in the usual charcoal furnace, and of casting these metals, after having been mingled in the correct proportions, in ingots. These bronze ingots, some time before the actual casting was undertaken, were charged into a cupola of the type used in iron and steel foundries. Thus the bronze was melted in one charge, with a more intense heat than would otherwise have been attainable, and with the result that it was more fluid.

The preparation of the mold to insure successful casting was another question that presented not a little difficulty. It seemed almost a hopeless task to attempt the casting of a plate 100 square feet in area and ⅜ in position by a powerful crane, and the remaining 1,800 pounds from crucibles, each manipulated by five men. The ladle with its 1,200 pounds of molten metal and the smaller crucibles in the hands of the men were tipped simultaneously. The trough and the gates leading from it to the mold served their purpose admirably. So ample was the provision for conducting the bronze to every part of the mold, that when the flask was removed and the sand broken away, a casting was found that was perfect in every respect. In order to lead away the gases impounded in the mold, numerous ducts had been made in the sand. From these the vapors poured in dense clouds for minutes after the metal had been cast.

The task of handling and turning a flask 25 feet long, 5 feet 7 inches wide, and 1 foot thick, weighing

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depot, composed of those who have not been enlisted for the first depot. The landstrum is also made up of two divisions, the first comprising those who have finished their term in the landwehr or the first depot, and the second all those who are not engaged in other service. The latest statistics of the Japanese army obtainable were given out in December, 1900, and placed the total active army at 8,046 officers and 158,214 men, and a grand total, including the various reserves, of 11,611 officers and 457,480 men. The active army was composed of the imperial guard comprising 14,110 officers and men, the twelve divisions comprising a total of 128,955, the Taiwan, Formosa, garrison comprising a total of 16,387, the gendarmerie comprising a total of 2,624, and the students and others comprising 1,978. There were 204,109 officers and men in the reserve, 98,722 in the landwehr, 51,966 in the first depot, and 109,581 in the second depot. Each of the 12 divisions of the army and the imperial guard as well comprises 2 brigades of infantry in 2 regiments of 3 battalions of 4 companies; 1 regiment of cavalry of 5 squadrons; 1 regiment of artillery formed of 2 campaign groups and 1 mountain group of 3 batteries of 6 guns; 1 battalion of pioneers of 3 companies; and 1 train battalion of 2 companies. There are besides, as troops not separated into divisions, 1 railway battalion and 1 battalion of telegraphers.

The number of artillery regiments is 13, each comprising 9 batteries—3 of them campaign and 2 mountain. The battery has an effective strength of 5 officers, 10 non-commissioned officers, 112 men, and 60 horses (37 for the mountain battery, 30 of which are draft animals). There is no heavy army field artillery. The officers of all classes are recruited at the special military school; those of the artillery afterward passing through the school of applied artillery and engineering. Before entering the special military school, the candidates admitted do a year's service in a regiment as simple soldiers; then they pursue the school course for two years and afterward spend six months in the regiment before being made officers.

The artillery establishments are: (1) The two powder mills of Itabaska (3.5 miles from Tokio) and Iwahaua in the province of Kozanke (72 miles to the north of Tokio); (2) the arsenal of Tokio, which comprises a manufactory of arms, a cartridge works, a repair shop, and a pyrotechnic laboratory; (3) the arsenal of Osaka, which comprises a gun foundry, a manufactory of gun carriages, a projectile foundry, and a pyrotechnic laboratory; (4) the arsenal of Taipe in the island of Formosa, to the west of Kilanny; and (5) the gun foundry of Kouse.

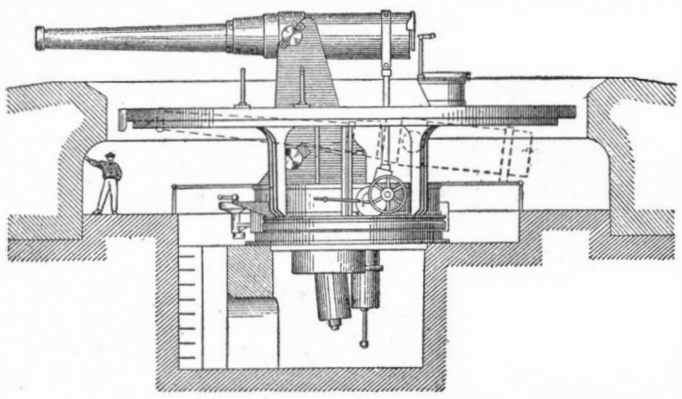
In Japan, the artillery is considered as the select branch of the service.

Coast Defense Guns.—It is probable that in the near future the Japanese will be independent of foreign makers in the provision of large guns for coast defense, just as they expect, with the increase of their naval gun-making establishments, to be eventually able to supply their new warships entirely with pieces of home manufacture.

The earlier coast-defense guns were made largely by the celebrated Schneider-Canet Company at Creusot, France. We present on the front page views of two types of guns for fortifications made at the French establishment for Japan. The one shown in the upper cut is a 10-inch gun upon a disappearing carriage and intended to be mounted in the manner shown by the accompanying line cut. The gun and mount are normally contained in a circular excavation. The gun is carried upon the upper ends of a pair of arms, which hold the gun trunnions. The lower ends of the arms are pivoted to a rotating carriage. The breech of the gun is supported by another pair of arms, and the mechanism is such that the gun can be lowered out of sight below the parapet for loading, the gun and crew during the operation being out of sight of the enemy, and sheltered from shell fragments by a horizontal circular overhead shield. The gun rises to battery through this shield, and recoils, on firing, back and down through a slot in the shield for reloading. The gun weighs 21¾ tons, the mount 61 1-3 tons, and the projectile 475 pounds. The initial velocity is 1,900 feet per second.

Of late years, however, the Japanese have abandoned the disappearing gun in favor of guns mounted "en barbette," the gun appearing permanently above the parapet. One of their guns of this type, built like the others at Creusot, is shown in the lower front-page engraving. It is carried on a gravity-return barbette carriage. The gun, by its trunnions, rests in the bearings of a massive cast slide, each half of which carries half a dozen steel rollers on which the gun moves in its recoil up the inclined paths of the lower rotating carriage. The usual recoil checks are provided and the gun returns to battery by its own gravity aided by the action of coil springs. The whole gun carriage is carried upon a circle of steel rollers, and the gun is elevated and traversed to right or left by the crank arms operated as shown in the engraving. The Japanese fortifications are armed with this type of heavy gun in various sizes.

Field Guns.—The present period of the transformation of the artillery finds Japan in possession of a 3-inch hardened bronze gun manufactured at the Osaka arsenal. This gun is provided with a screw fermature and ordinary pointing devices. It throws an 8.8-pound belted copper shell with an initial velocity of 1,380 feet. It is drawn by small horses of the pony type, the rations of which consist of 11 pounds of hay and 9 quarts of barley.

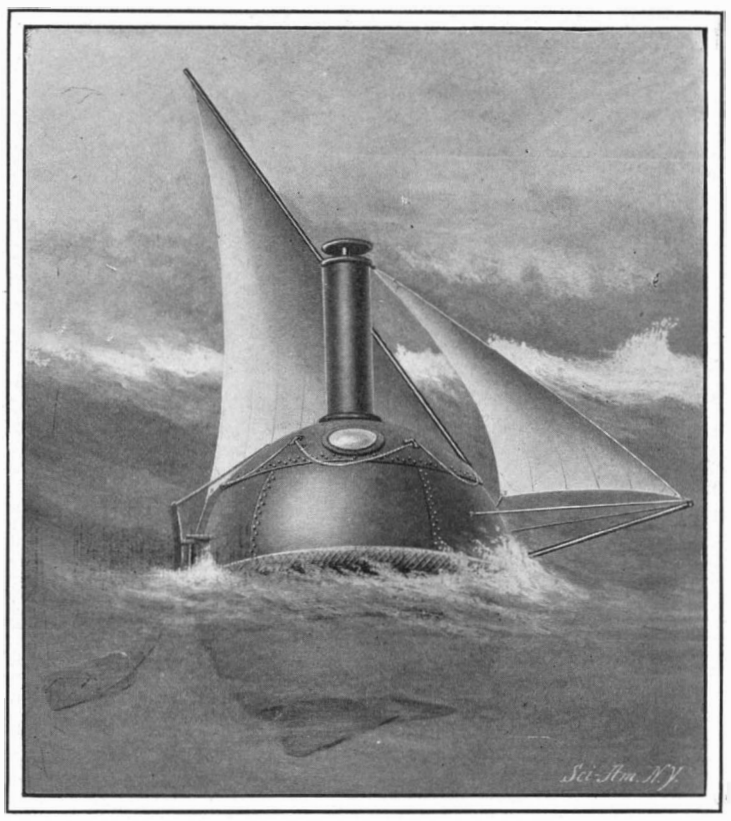


EMPLACEMENT OF A 10-INCH JAPANESE DISAPPEARING COAST DEFENSE GUN.

The mountain gun is of the same caliber and throws the same projectile with the same initial velocity.

Awake to the progress of Europe, Japan has submitted the question of the rapid-fire gun to deep study; and although she has, indeed, made an appeal to European industry for aid in this matter, she has rather preferred to rely upon her own resources and has adopted a gun devised by Col. Arisaka. Although the full particulars of this gun are not definitely known, it is fairly certain that it possesses in full those elements of rapid fire that distinguish the latest rapid-fire artillery of European nations. That it is a most effective piece is proved by the crushing fire which it delivered against the Russian entrenchments at the battle of the Yalu, when the enemy were so thoroughly shaken up that they could not withstand the subsequent infantry attack.

Machine Guns.—Japan, in 1902, organized two batteries of machine guns and assigned them to the two first divisions. One of them is provided with 6 Maxim guns and the other with 6 Gatlings. Experience will decide as to the selection to be made between these two systems. Each battery comprises 3 officers and 52 men. The instruction as to the use of the guns makes it incumbent upon the division commander, in time of war, to assign a section to each of the brigades of infantry and to the regiment of infantry of his division.



CAPT. DOENVIG'S LIFE-SAVING GLOBE.

The iron industry of Alabama is represented at the World's Fair by a colossal iron statue of Vulcan, fifty feet high and weighing 150,000 pounds. It was made in Birmingham, to portray the importance of that city as a manufacturing point. The base of the statue is made of coal and coke. This cast-iron Vulcan occupies a place in the Palace of Mines and Metallurgy.

CAPT. DOENVIG'S LIFE-SAVING GLOBE.

It is now about a year ago since the first trials were made with Capt. Doenvig's new invention, the life-saving globe. These were all preliminary, however, and it is the practical tests, now just finished, that beyond all doubt have established the reputation of the new invention.

These recent trials were conducted on the coast of Jutland in very stormy weather, under the supervision of Norwegian naval officers and other maritime authorities. Two life-saving globes were used for the experiment. They were both set out from the Norwegian man-of-war "Heimdal." The first one had no human beings on board, but sand ballast corresponding to the weight of sixteen men. It was launched without trouble, and made a successful landing.

This fact ascertained by signals from shore to the "Heimdal," the second globe was set out. On board this one were Capt. Doenvig, Marine Lieutenant Engelstad, and three sailors. This also cleared away from the ships in good shape, and a few minutes after its being dropped into the sea, one of the trapdoors was opened, the men crawled out, swinging the Norwegian flag, set up sails, and sheered through the breakers toward land. It made a successful trip, and half an hour later it landed. At the time it was blowing hard from northeast, and the sea broke on four feet of water. The globe landed about fifty yards from the mainland. The men got out and waded ashore. By experts it was considered that an ordinary lifeboat would have been of no use under the circumstances.

The globe is made of sheet iron 5-16 inch thick at the bottom, 3-16 inch at the sides, and ⅛ inch at the top. It is 8 feet in diameter and 6½ feet high, and has a double bottom. It draws 2½ feet of water when loaded. The globe may be entered through three water-tight trapdoors. Under the deck, which is located about one foot below the waterline, are placed four galvanized-iron tanks, with capacity for holding 150 gallons of fresh water. Along the sides runs a low seat or bench, and the space underneath the same is filled with canned goods. In the center of the inner room is a funnel, that can be shoved up, thus letting fresh air into the globe.

There are three small windows in the top, for the double purpose of letting in light and providing openings through which rockets can be sent up. The globe has a movable keel, which can be let down from the inside, and also a rudder that may be applied in the same manner. Some small oars are also kept inside. A cork belt runs around the globe on the outside, on which the men can stand and row. There is also an anchor with 100 feet of steel rope attached, and a set of small sails, the funnel serving as mast.

There is no need for launching the globe; when the ship sinks, it will simply float. Its weight is about two tons, or the same as that of a large ordinary lifeboat. It cost about $500, and has accommodation for twenty men. It requires less deck space than an ordinary lifeboat.

An interesting statement bearing on the future of great cities was embodied in an address recently made by Prof. H. B. Smith, of the Worcester Polytechnic Institute, speaking of electrical transmission of power. He said that in San Francisco a few years ago the cost of electric current for power and light was 15 cents for one horse-power per hour, while to-day the published price is almost exactly one-seventh of this amount, and it is possible to deliver at the factory on the coast, from the melting snows and glaciers of the Rockies, power for the machinery at a smaller cost than that at which it is possible to produce that power by steam, even though the fuel were to be delivered at the factory boiler without cost to the power producer. It has been estimated that the quantity of carbonic acid annually exhaled by the population of New York city is about 450,000 tons, and that this amount is less than three per cent of that produced by the fuel combustion of that city; so we may expect that, with the removal of this great source of contamination of the atmosphere, even the air of our greater cities will be practically as pure as that of the country.

The chief use for acetylene in Canada is as an illuminant in dwellings. On the river St. Lawrence the buoys are lighted with acetylene gas, the gas being compressed into the buoys under ten or more atmospheres. The gas passes from the reservoir to the burner through a reducing regulator. The buoys are sufficiently large to supply gas to the burner for from three to six months without recharging. The buoys can be recharged without being removed from their positions, a steamer with a specially-constructed generating apparatus and a pump for compressing the gas being employed for this purpose.

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RECENTLY PATENTED INVENTIONS.

Machines and Mechanical Devices.

HYDRAULIC AIR-COMPRESSOR.—W. G. Cox, New York, N. Y. One purpose of the invention is to provide an economic form of hydraulic air-compressor so constructed that water may be admitted at either side through what may be termed a "double chamber," one section of which chamber acts as a cushion to the incoming water, thus preventing hammering of the inlet-valve, which latter is especially formed to the same end.

CARRIAGE FOR OVERHEAD CABLES.—T. ALEXANDER, Brookhaven, Miss. In this patent the invention relates particularly to improvements in the construction of the track or carriage, whereby improved advantages are obtained in respect to the strength, durability and operation; also, in relation to means for dogging or locking the carriage to a hauling-rope, which runs alongside the track-rope; also, in means for supporting the load from the carriage; also, in improvements in guides and supports for the hauling-rope on the framework, to which the track-rope is secured and by which it is supported.

ELEVATOR.—P. F. FOLEY, New York, N. Y. The invention relates to an improvement in the elevator disclosed in a prior patent granted to Mr. Foley. In the apparatus shown in this patent a form of differential sheave and cable gearing is employed, involving a counterweight and tension-weight mounted in two separate shafts or vertical guideways. This arrangement is disadvantageous in that considerable room is occupied in providing the two independent shafts. An object of the present invention is to provide a construction which allows the sheave-weight and counterweight to move in the same shaft, thus economizing space in the building.

MOLD FOR CONCRETE WALLS.—C. E. SHUMWAY, Albion, Mich. In this instance the invention relates to improvements in molds for concrete walls; and the object in view is to provide an improved machine by which a double wall, with an air-space between the adjacent or parallel courses, may be rapidly and economically constructed by unskilled labor.

MACHINE FOR PACKING FLOUR INTO BARRELS OR SACKS.—L. VAN NETTE, Bradford, Pa. Mr. Van Nette's invention relates to a machine especially designed for use in flouring-mills to be used for packing flour into barrels or sacks for market by the simple compression of the flour into these receptacles, thereby avoiding the employment of the auger almost universally used in the present methods of packing.

Pertaining to Vehicles.

THILL OR DRAFT-POLE COUPLING.—H. TURNER, Koolunga, South Australia, Australia. The object in this case is to provide details of construction for a thill or coupling which in duplicate affords means for detachably connecting a pair of shafts or draft-pole to the front axle of a vehicle, which will hold the thills or pole free to rock in a vertical plane, prevent rattling of the hinged parts, and permit a quick detachment and interchange of the thills or the pole connecting with the front axle without use of tools.

RUNNING-GEAR FOR WAGONS.—J. GREAR, Paducah, Ky. This invention is an improvement in the axles and connected parts of the frame of running-gear for wagons and carriages, the objects being increased lightness, durability, strength and economy of manufacture. In the manufacture the several parts, save the blocks that constitute the bearings and the journals proper, are struck up from sheet or plate metal by means of suitable dies and are thus very cheaply produced.

SUPPORT FOR VEHICLE-TOPS.—B. K. HENDRICKS, Cain Point, Ill. The objects of Mr. Hendricks' invention are to prevent the bending and breaking of the bows when the top is laid down, reduce the bouncing up and down of the top when in use, thus making the top last much longer, improve the appearance of the vehicle, and permit it to be taken under low sheds and doors.

Prime Movers.

PROPELLING MECHANISM FOR BOATS.—B. J. LAVIGN, New York, N. Y. The purpose of this invention is to provide an effective propelling mechanism for boats, particularly of that character which is driven by foot or pedal power, and, further, to provide means whereby the speed of the mechanism may be increased or diminished as desired, and in an expeditious and convenient manner under the full control of the operator.

Of General Interest.

CLAMP FOR HOOPS, BANDS, ETC.—W. P. RICE, Lowell, Ohio. The principal object of Mr. Rice's improvement is to provide a device which may be quickly and readily applied to a tub, cask, or the like, and may be adjusted to fit casks of varying circumference, so that the necessity of employing rivets or similar fastening means is obviated.

MIRROR.—L. B. PRAHAR, New York, N. Y. In this case the purpose is to provide a construction of mirror, especially hand-mirror, whereby the glass may be held in a contractile frame or a divided frame with means for placing it under tension without danger of the reflector, no matter how thin the glass, from being checked or broken while securing it in position or when the mirror is subjected to any edge strain during transportation or accident in handling.

CONSTRUCTION OF FLOORS, PARTITIONS, OR THE LIKE.—V. MOESLEIN, Weehawken, N. J. In this patent the object is to provide improvements in the construction of floors, etc., whereby an exceedingly strong and durable support is produced for holding the plaster and for supporting filling material that may be employed, the floor, etc., being completely fireproof and arranged to permit the use of unskilled labor to place the parts in position.

BEAD-LOOM.—H. B. MEES, Nadeau, Kan. In carrying out this invention Mr. Mees has particularly in view the provision of a small loom which will hold the warp-threads apart in such manner that they may be stretched taut and equal distances apart, thereby obviating the possibility of the threads loosening and spoiling the work.

MAIL-BOX.—A. M. HOES, St. Paul, Neb. In this patent the invention has reference to improvements in mail-boxes for rural service, the object being to provide a box of this description that will be of simple construction, inexpensive, having no parts liable to get out of order, and so arranged that it may be easily opened and closed. The box may be made of any suitable metal.

GAS-LIGHT NEGATIVE-PRINTING ATTACHMENT.—G. W. HARSE, New York, N. Y. One object the inventor has in view is the provision of a light and cheap device which may be easily fitted to an ordinary gas-burner to expose a negative and the sensitized paper held in an ordinary printing-frame to the rays of light. The gas-burners may be with or without incandescent mantles.

INKSTAND.—G. A. GRIGGS, Billings, Mont. The purpose in this case is to provide an inkstand in which the feed-funnel is employed to supply ink to the pen-nib, the funnel being depressed at each dipping, and to construct such an inkstand so that it will be reliable in all temperatures and so that the chamber is fully open at the bottom and practically closed at the top, being reversed when filled, which filling can be quickly and cleanly done, and also to so construct it that in use the ink will not overflow.

CHECK-PUNCH.—T. K. DAVISON, Jamestown, N. Y. In this patent the invention has reference to improvements in devices for puncturing the value-marks for banking checks, an object of the inventor being to provide a device for this purpose that will be simple in its construction, having no parts liable to get out of order or break, and that may be conveniently carried in a person's pocket.

BRICK FOR THE CONSTRUCTION OF ARCHES.—S. H. CLARKE, Cuzco, Minehead, Somerset, England. The improvement is designed more particularly for use in situations where the structure of the arch is liable to disintegration and collapse, the improved brick tending to avert the risk of collapse, and, furthermore, enabling an arch to be built and repaired readily and quickly without specially-skilled labor, an advantage of utmost importance in the case, for example, of the furnace-arches of marine boilers using liquid fuel.

REFRIGERATOR-CAR. — J. S. BASHAW, Gainesville, Fla. In this patent the invention refers to an improvement in refrigerating-cars which enables Mr. Bashaw to adapt a car of ordinary construction to use as a refrigerator, this end being attained, generally speaking, by providing one or more ice-tanks of peculiar construction which are capable of being placed in the car through the usual door thereof. Means are involved for circulating air through the car.

GLOVE.—W. LEFI, Gloversville, N. Y. The object in this case is to provide improvements in gloves having outside seams, and more particularly at the joint of the thumb and body portions, whereby a very strong, durable, and well fitting glove is produced and the strain incident to putting on the glove or when carrying packages or umbrellas, holding reins, etc., is more on the leather instead of on one portion of the seam joining the thumb to the body portion.

LEDGER-BINDER.—L. E. SCHOCH, Chicago, Ill. The invention has particular application to devices of the class commonly known as "loose-leaf" or "perpetual" ledger binders. Primarily the inventor has in view as an object the construction of a binder of the class described which may readily receive a large number of loose leaves, and which may be locked securely in such maner that the leaves will be firmly clamped between the covers of the binder.

FOLDABLE BEDSTEAD.—C. P. BROWN, Springlake, Mich. In this instance the invention refers to improvements in foldable bedsteads by which the inventor seeks to produce a construction enabling him to utilize a standard metallic head-section, a similar foot-section, and a standard bed-frame in a way to fold the parts compactly when it is not desired to use the bed and at the same time allow the several parts to be easily and quickly unfolded for use.

BOX-LID HOLDER.—C. S. CHRISTIANSON, Reynolds, N. D. This invention relates particularly to improvements in devices for holding lids of cigar-boxes open at any desired angle for displaying goods, the object being to provide a device for this purpose that will be simple in construction, readily applied, and that when in position will occupy very little space.

CORE-DRYING OVEN.—W. J. BREEN, Mahwah, N. J. The primary object the inventor has in view is the provision of a construction by which a large number of small or medium-sized "green" cores may be handled without injury or breakage during the operation of placing them in the oven, drying the cores, and removing them from the oven.

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Inquiry No. 5549.—For the makers of Goobers' pocket check protector.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 5550.—For manufacturers of putty and machines for making the same.

FOR SALE.—Patent on hand portable fire-escape or royalty. Inventor, 4128 Steele Street, Denver, Colo.

Inquiry No. 5551.—For manufacturers of cracker-making machinery.

American inventions negotiated in Europe. Wenzel & Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 5552.—For manufacturers of small ice-making machinery.

For Sale or Royalty.—Patent. Multi-color job printing press. Entirely new. C. M. Shigley, Columbus, O.

Inquiry No. 5553.—For drills for drilling hard rock under water.

Young man desires agency of good article for country neighborhood; good references. F. E. Chace, Pawtucket, R. I.

Inquiry No. 5554.—For the address of Mr. Hugh L. Willoughby, for whom there is a letter in this office.

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Inquiry No. 5555.—For manufacturers of tools and machinery for making lead bends, traps, etc.

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The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 5557.—For dirt-conveying machinery for use in constructing dams, etc.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 5558.—For makers of and dealers in quarrying machinery and supples.

I want the agency or right for any good-selling article. Send sample and full particulars.

H. H. Rice, Beloit, Wis.

Inquiry No. 5559.—For makers of broom-making and paper bag-making machinery.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5560.—For manufacturers of paper.

Export to Australia.—Gentleman having good connection wishes to represent first-class American manufacturer. Address N. LeRoy Tracy, care of Tracy, Robinson & Williams Company, Hartford, Conn.

Inquiry No. 5561.—For address of makers of household specialties, of small steel wire.

WANTED.—To manufacture on reasonable terms anything in wood or metal. First-class facilities for manufacturing and shipping. Satisfaction guaranteed. Send samples for estimate. Wayland Incubator & Manufacturing Co., Wayland, N. Y.

Inquiry No. 5562.—For makers of working model steam engines.

Inquiry No. 5563.—For makers of wood fiber machines.

Inquiry No. 5564.—For a small stationary air engine.

Inquiry No. 5565.—For the manufacturer or inventor of the automatic coin-operating, type-setting and stamping machine.

Inquiry No. 5566.—For the present address of the Armat Moving Picture Co.

Inquiry No. 5567.—For the manufacturers of leatherette wall pockets.

Inquiry No. 5568.—For manufacturers of garter buckles.

Inquiry No. 5569.—For makers of the "Massey" vise, for pipe and vise combined, called the "Massey Perfect No. 25."

Inquiry No. 5570.—For makers of accordion-plaiting machines.

Inquiry No. 5571.—For a machine drill not too heavy, but strong enough to put in a 3-foot hole for blasting in quarry work.

Inquiry No. 5572.—For a schooner about 140 feet long.

Inquiry No. 5573.—For a heater to furnish heat in buildings.

Inquiry No. 5574.—For the address of the makers of the McLaughlin hub and axle.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9398) J. W. S. says: Kindly inform me through the notes and query column of the SCIENTIFIC AMERICAN whether there is any known chemical or agency known to science that will dissolve or destroy air; that is, whether there is any chemical or other agency known that, being placed in an air-tight cask, will dissolve or destroy the air contained therein, and if so, what are they? A. We do not know any chemical which will destroy air and thus produce a vacuum in an air-tight cask. This is what we understand your question to mean. Phosphorus will consume the oxygen of the air slowly in any air-tight place, and thus produce a partial vacuum. But the nitrogen and carbon dioxid which are always present in the air cannot be disposed of in this manner, nor indeed is there any way known to chemists by which the nitrogen can be transformed directly into a solid.

(9399) C. A. R. writes: Will you please explain, through your question column of the SCIENTIFIC AMERICAN, the action and theory of a reactive coil, such as is used in Thompson's electric hoop welding? A. The common name of reactive coils is choking coils, a name which more clearly indicates their functions. These coils act as rheostats in direct-current circuits, to restrain the flow of current. This they do by their self-induction. A clear presentation of this subject may be found in Sheldon's "Alternating Current Machines," which we send for $2.50.

(9400) C. E. B. says: I have a very handsome old mahogany table that has been varnished, and would like to know how to put a high polish on it, as you see on new tables that have never been varnished. What I want is polished wood, not varnished wood. A. To produce a wood polish, you must remove the old varnish with sandpaper, and finish the surface by a thorough rubbing with a cloth pad and turpentine; then rub to a bright finish with thin shellac varnish, applying but little at a time on the pad.

NEW BOOKS, ETC.

O'GORMAN'S MOTOR POCKET BOOK. By Mervyn O'Gorman, M.I.E.E., Assoc.M. I.M.E. New York: E. P. Dutton & Co., 1904. 12mo.; pp. 387. Price, $3.

This little volume is a practical pocket handbook for the automobilist. It is arranged in the form of a dictionary of automobile terms and topics, all the words being given in English, French, and German. Besides tables in these three languages of words used in first aid to the injured, in regard to time, clothes, drinks, and other subjects of importance to the tourist, there are numerous other tables of value giving, for example, the number of revolutions different sized wheels make in a mile, speeds in miles per hour corresponding to times by seconds from one to three minutes, equivalent temperatures in Fahrenheit, Reaumur, and Centigrade, the specific gravities corresponding to the degrees on the Baumé scale, etc. The book also contains full instructions upon taking an automobile into France for touring purposes. There is a great deal of practical information within its pages, and much of this information is made very clear by nearly 500 cuts.

MACHINES AND TOOLS EMPLOYED IN THE WORKING OF SHEET METALS. By R. B. Hodgson, A.M.I.M.E. Manchester, England: Technical Publishing Company, Ltd., 1903. 12mo.; pp. 311. Price, $2.

The scarcity of literature upon presses and press tools will cause this book to be welcomed by all sheet metal workers, as in its pages will be found very thorough descriptions of the various kinds of presses and tools used in this industry, as well as of the methods of operation of the same. The 281 illustrations in the book include pictures of typical power presses, the said pictures being supplemented with accurate descriptions. Calculations and definitions of sufficient number have been interspersed throughout the text in such a way as to allow any practical mechanic to grasp the points under consideration with the least possible calculation.

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RUBBER, GUTTA-PERCHA, AND BALATA. By Franz Clouth. New York: D. Van Nostrand Company, 1903. 8vo.; pp. 250; illustrated. Price, $5.

This is the first English translation from the German edition. Speaking of the scope of the work, the author says: "Everything worth knowing about India rubber and gutta-percha is exhaustively dealt with." The treatment is systematic and thorough, valuable features of it being the botanical cuts, the maps showing the geographical distribution of rubber plants and of gutta-percha supply plants, and the chart giving price-fluctuations of Para rubber since 1861. The first division of the work deals with India rubber, its natural history, the production of the raw material, commercial points, chemical and physical properties of the raw material, the production of soft rubber goods, vulcanization, the chemical and physical properties of vulcanized soft rubber, hard rubber, or ebonite, and regenerated and artificial rubber. The second division of the work, dealing with gutta-percha, follows the same general plan, as does the third division also, on "balata," except that this is disposed of in one chapter, its importance being relatively small, although, under certain conditions, it manifests properties which make it, for use under such conditions, superior to gutta-percha. In view of the wide interest that is now being manifested in the experiment of rubber cultivation, the book should find a ready sale among American readers.

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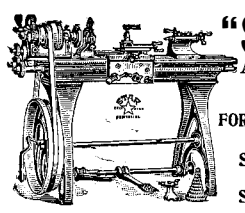

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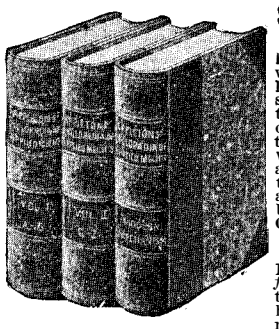

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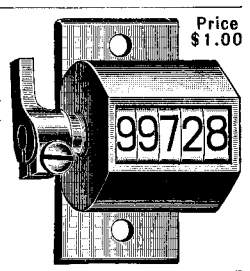

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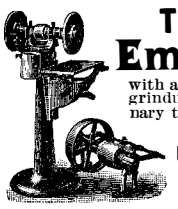

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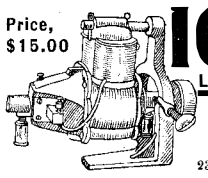

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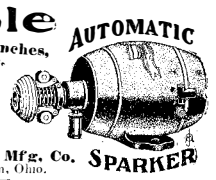

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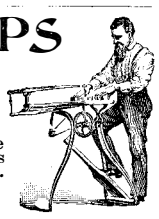

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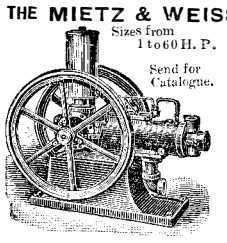

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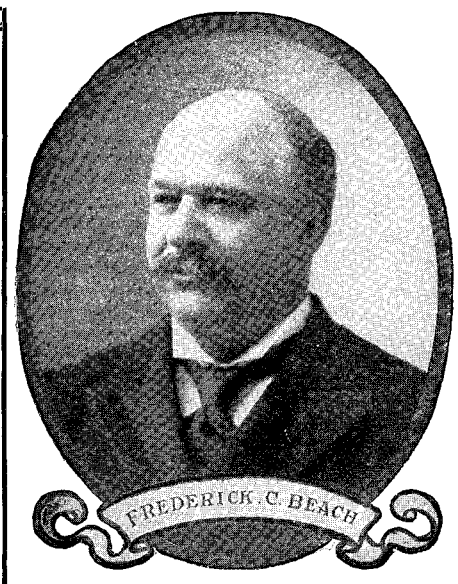

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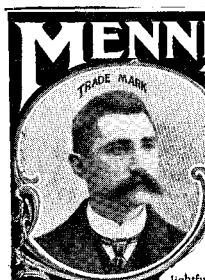

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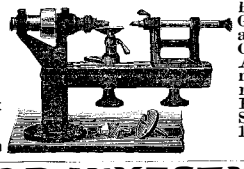

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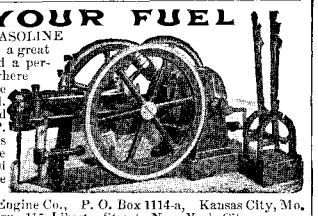

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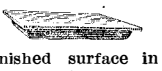

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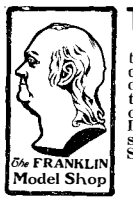

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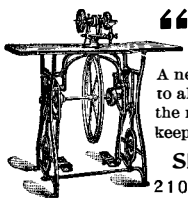

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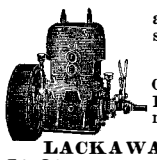

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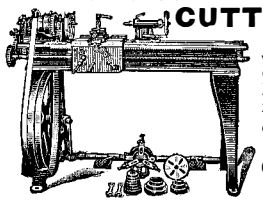

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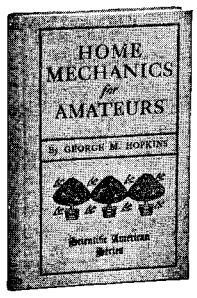

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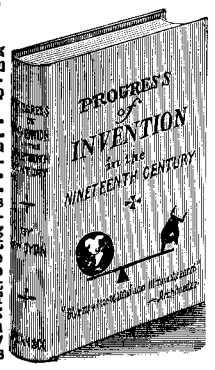

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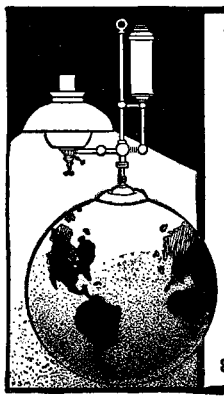

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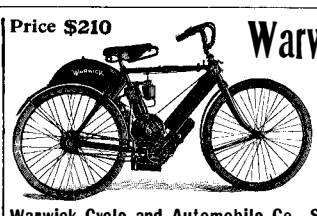

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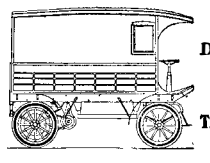

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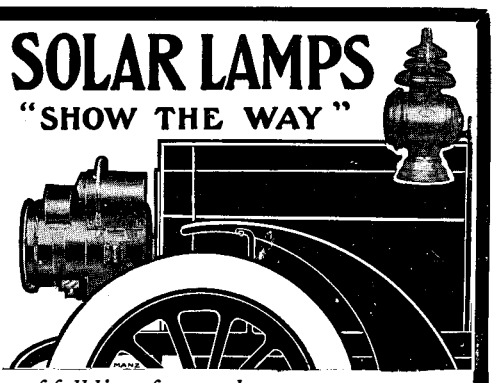

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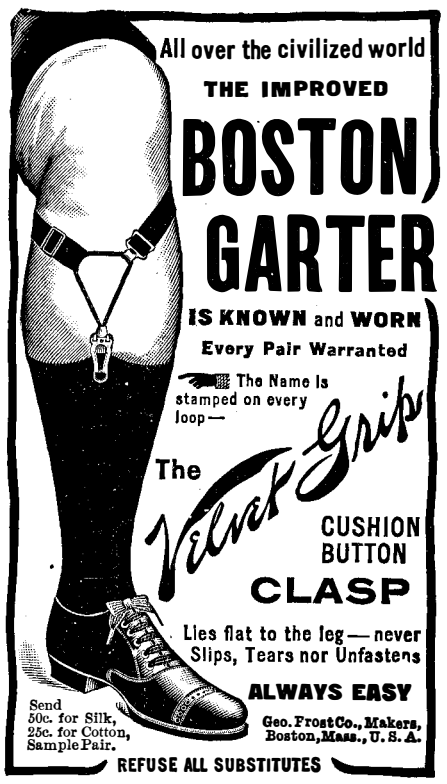

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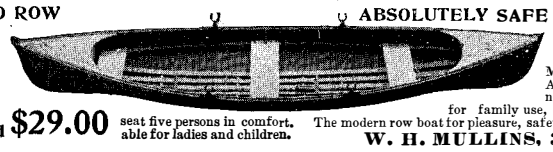

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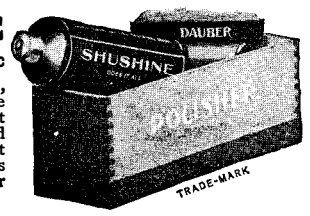

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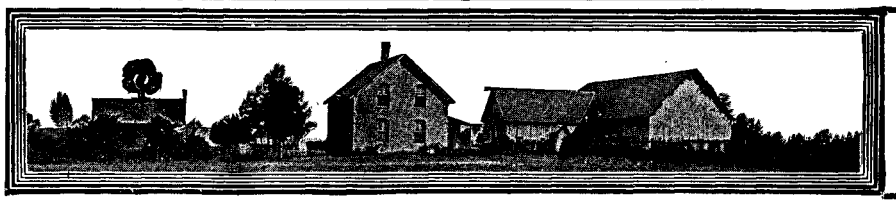

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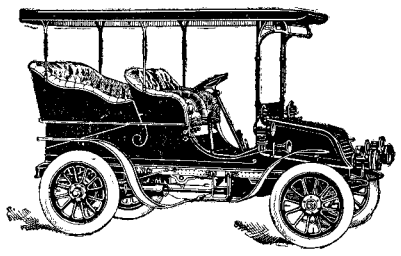

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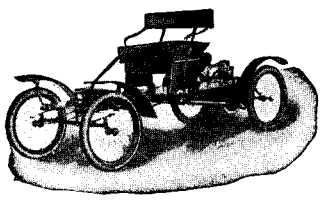

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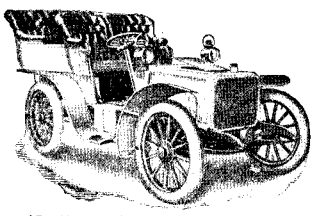

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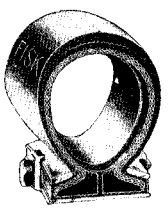

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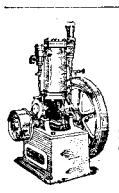

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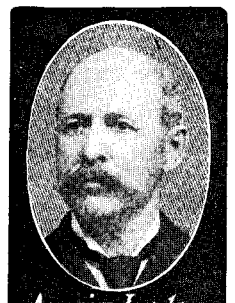

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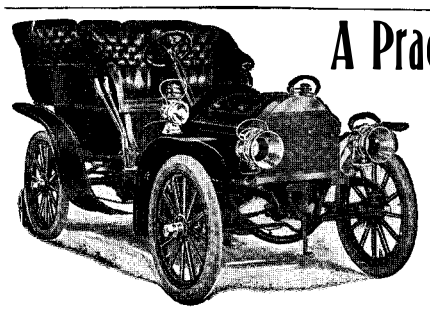

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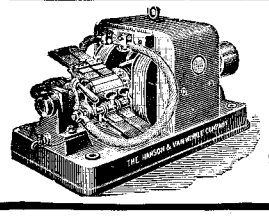

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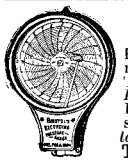

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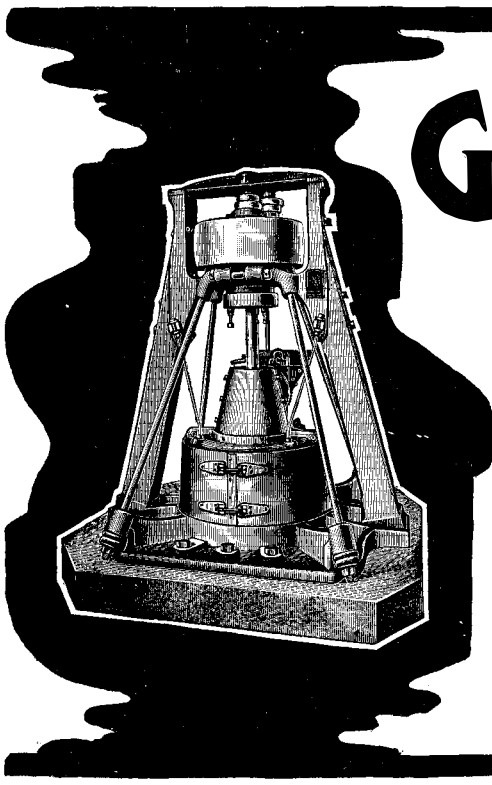

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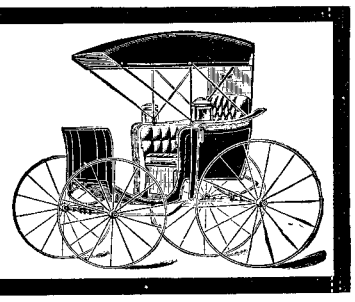

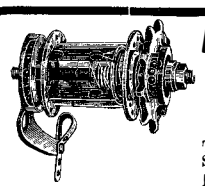

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